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ATTITUDE IN RELATION TO THE PSYCHO-PHYSICAL JUDGMENT[1]

By S. S. George

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In psychophysical work the *doubtful* judgment has always given difficulty. At first it was a question how this judgment should be treated mathematically; later, when rules were established for dealing with *doubtful* cases or 'or-judgments' as intermediate categories, the question turned upon the nature of the *doubtful* judgment itself. The judgments 'greater,' 'equal,' and 'less' may be passed upon stimuli and sense-impressions; but what is there about stimuli or sense-impressions that leads them to be reported as *doubtful?* Rather

[1] From the Psychological Laboratory of Cornell University.

Printed in Germany.

it would seem to be the observer who is doubtful. In admitting that judgment, do we not allow a change in the reacting organism, whose constancy is a necessary presupposition of the psychophysical determination?

This question constitutes the principal problem of the present study. We first tried to examine the *doubtful* judgment directly, and to determine whether it necessarily or even usually represents a change in the attitude of the reacting organism. It soon became evident however that we could not attack the problem successfully in this way. We therefore sought by an instruction to compel the observer to maintain a constant attitude or disposition while giving judgments. We wished to see whether or not *doubtful* judgments would occur under this instruction; and if they occurred whether they gave evidence of a dispositional shift which violated the instruction. The evidence of such a shift was to be obtained both directly, from the reports of the observers, and indirectly, from change in their reaction-times of judgment. We hoped also to secure evidence of other attitudinal changes, if they occurred, and to trace their influence. We planned further to examine the status of all the categories used by the observers under the instruction. We specifically suggested the 'or-categories,' which are often used interchangeably with *doubt*, and the category 'no-difference,' which we thought might prove to be a truly impressional judgment that could fitly replace the judgment *doubtful*.[2] And since there is no *a priori* proof that an attitudinal change is not involved in the fundamental categories, 'greater,' 'equal,' and 'less,' we sought for empirical proof of their occurrence under a constancy of disposition.[3]

We have thus aimed to distinguish between intra-serial change, expressed in the law of the psychometric function, and extra-serial change due to gross shift of the observer's attitude. The organism is never constant, and its inconstancy is measured whenever a psychophysical correlation is made; when, *e. g.*, the correlation is a limen, the measure of intra-serial change is the measure of precision, *m. v.* or *h*. But

[2] The category 'no-difference' did not, in fact, realize this logical expectation.

[3] We are obliged, for reasons of space, to omit historical references to discussions of the *doubtful* judgment (we have found but few that bear at all directly upon our problem), as well as the discussion of certain published results, suggested by the results of our own inquiry. Our general position is closely related to that of S. W. Fernberger (this JOURNAL, XXV, 1914, 538 ff.), though we have approached the problem of attitude from a different direction.

this inconstancy, the range of play within the neural machine, is different from the inconstancy which results when the machine is given a different set, and so becomes in reality another machine. Extra-serial changes lie outside of the series of categories prescribed by the experiment; they cannot be taken account of, or measured; they should therefore be, so far as possible, excluded.

The Instructions

In the preliminary work definite categories were recommended. We wished our observers to take the judgment-scale as a whole, as a single complete series limited on the one side (say) by 'greater' and on the other by 'equal.' The instruction follows:

"You are to report on the relative intensity of two sounds; the second to be judged in terms of the first. The second, in this series, will always be greater or equal; and you will therefore be required to judge in categories whose limiting judgments are greater and equal. These categories are: greater, greater or no-difference, no-difference, no-difference or equal, equal. You will be asked after every judgment to give the introspective basis of your report. You are to judge with full attention."

This procedure, however, failed to secure the desired results. It soon became clear that no one of our observers was maintaining anything like a constant attitude toward the sounds. They were rather taking every judgment by itself, unrelated to the other types of judgment. We wanted them to realize a *series* of prescribed judgments, which would lie in one and the same straight line, and to judge with respect to a *gradation* that should remain true to the shades and nuances of a single mental attitude. The instructions were therefore changed as follows:

"You are to report on the relative *intensity* of two noises: the second to be judged in terms of the first. In this series, the second stimulus will always be greater than or equal to the first.

"You are to employ judgment categories of a *serial* nature; that is, you are to keep your receptive attitude constant throughout. Such categories might be: greater, greater or no-difference, no-difference, no-difference or equal, equal, . . . less.

"You are to judge with full attention. After judgment, you will make a report to the experimenter, noting especially (1) any gross shift of attitude, and its conditions; and (2) the conditions of change from one judgment category to another, such as may occur without change of general attitude."

The instructions were varied in a 'less'-series, by substituting the word 'less' for 'greater' throughout; while in the visual series the word 'extents' was used instead of sounds, and 'right' and 'left' instead of first and second.

The preliminary practice of the observers with the first instruction lasted, excluding the summer months, as follows: F, May to November, 1915; Bo, May to October, 1915; Bi, April to October, 1915; R, April to November, 1915; E, October 20 to 30, 1915.

Thus all the observers but E had, at the beginning of the final series, fairly extended practice in adjustment to the general experimental conditions, but as yet no specific adjustment to the new instructions. We have based the discussion of this paper entirely upon the series taken under the final instructions.

Apparatus and Method

We worked throughout with Fechner's sound-pendulum[4] for judging the intensity of sounds and with Wundt's frame[5] for judging visual extents.

A new attachment to the pendulum allowed us to work with close divisions on the scale. The attachment was a metal piece, about 5 cm. long, which fitted over the scale itself; in it were scale-divisions cut through the metal as grooves. The experimenter held the pendulum by a thin piece of hard wood which he placed in a groove; he released the ball by withdrawing this piece of wood.

The observer sat with his back to the apparatus. The time-interval between the two successive sounds was one second, controlled, together with the times of the warning signals, by a soundless metronome.

On the frame were two black lines, 2 mm. in breadth. The standard (left) was 33 mm. long. The variable (right) was drawn partly on the paper beneath the glass and partly on the inner surface of the glass. The two sections slid perfectly, the one beneath the other, so that qualitative differences along the length of the line were not distinguishable.

The observer sat a distance of about one meter in front of the frame, with his head in a head-rest. A cardboard shutter on a lever was used to expose the lines. The exposure time was one second. This time and the time of the warning signals were controlled by the soundless metronome.

The judgment-times of the observers were recorded upon a sinking kymograph in an adjoining room. The kymograph was started and stopped electrically from a switch under the experimenter's control. The time-line was written by a fork of 50 vs. The pendulum and the exposure-shutter of the frame were electrically connected to mark on the drum the termination of the period of stimulation; a lip-key in the observer's mouth gave the record of the time of judgment.

In both the auditory and the visual series we worked with very small units, one scale division on the pendulum and $\frac{1}{6}$ mm. on the frame. Usually a series contained from 7 to 10 steps; thus about half of the stimulus-differences lay below the D. L. We used a modified method of limits, in which we passed always from either 'greater' or 'less' to objective equality, irrespective of the variation of O's categories. In about half of the series a report was taken after each observation; in the other series no reports were taken.

Under our instruction, the observer knew that the stimuli would be either greater (less, in the alternate case) or equal. We supposed that such a procedure with knowledge would eliminate expectation; but it did not. Whenever the observer seemed to suspect that the method was a method of limits, and consequently to anticipate that the series would begin with a difference and end with equality, we introduced an irregular series in which the stimulus pairs were given in haphazard order.

The Observers

Our observers were Dr. W. S. Foster (F), instructor in psychology, highly practised; Dr. E. G. Boring (Bo), instructor in psychology,

[4] G. T. Fechner, *Elemente der Psychophysik*, 1860, I, 176; E. B. Titchener, *Experimental Psychology*, II, i, 81; ii, 195.

[5] Z. Radoslawow-Hadji-Denkow, *Philos. Stud.* xv, 1899, 324; Titchener, *op. cit.*, II, ii, 257.

highly practised; Mr. H. G. Bishop (Bi), assistant in psychology, well practised; Mr. G. J. Rich (R), graduate student, majoring in psychology; and Miss G. English (E), graduate student, minoring in psychology. E was the least practised observer. F, Bi, and E worked with sound stimuli, Bo and R with visual stimuli.

Statistical Treatment of Results

Table I gives an analysis of the entire experiment under the final instruction. Reaction-times were obtained for only about 75% of the total number of judgments; some series were taken without times, and sometimes the apparatus failed to work. The individual differences in reaction-time should be noted; the average time for F is more than twice as great as for Bi.

The data of Table II were computed in order to determine whether it would be necessary to treat separately the reaction-times of the series in which reports were taken and those of the series in which no reports were taken. The table shows the excess of the average time in the report-series over the average time in the no-report-series. A negative value means that the times were longer when no reports were taken. The differences shown are all very small, and there appears to be no general trend. The averages of all observers and all categories are, in the two cases, practically identical. We have, therefore, hereafter thrown together the times of the two types of series.

Table III shows the effect of practice upon the times and upon the occurrence of the different categories. The average reaction times (secs.) are computed for successive groups of 25 series each. These groups are indicated by the numbers I, II, III, and IV. In the cases where the number of series is not divisible by 25 (F, Bo, Bi, and E; see Table I for number of series in each case) the last group for each observer is an average for all the series remaining after the preceding 25 series had been taken. In general, F, Bo, and R show a practice-effect in the shortening of the times; Bi and E do not. The averages for all observers and all categories, shown at the bottom of the table, indicate that there is, in general, little change after the first 25 series.

Table IV shows the frequency of occurrence of the various categories expressed in numbers of cases.

The average times for the different observers and categories appear in Table V. In the last line of the table are given the averages of all the cases under each category (not averages of the averages of each observer), for the purpose of the com-

parison of the categories. These values do not, however, constitute a very satisfactory means of comparison, because

TABLE I

ANALYSIS OF EXPERIMENT

Observer	F	Bo	Bi	R	E	All
Number of series taken	42	78	91	100	65	376
Number of judgments taken	377	718	799	868	586	3348
Number of judgments taken with times	269	580	579	719	382	2529
Average reaction time (seconds)	1.50	0.83	0.72	1.14	1.10	1.00

TABLE II

COMPARISON OF REACTION-TIMES FOR SERIES WITH AND WITHOUT REPORTS

Figures show in seconds the excess of reaction-times for series with reports over reaction-times for series without reports. No figures are included in this table when either reaction-time involved is an average of less than ten cases.

In this and all subsequent tables the following symbols are used to designate the different categories of judgment:

g, greater
=, equal
l, less
nd, no-difference
g=, greater-or-equal
=l, equal-or-less
g.nd, greater-or-no-difference
nd=, no-difference-or-equal
nd.l, no-difference-or-less
g?, greater-doubtful
l?, less-doubtful
=?, equal-doubtful
?, doubtful (or "don't know")

Observer	g	g=	g.nd	nd	nd=	=	nd.l	=l	l
F	−.06					+.14			−.04
Bo	0					−.10			−.04
Bi	+.06	−.02				+.04		−.02	−.04
R	+.06		+.16	−.02	+.12	+.08	+.06		−.02
E	+.14	+.04				−.22			+.10

Average reaction-times of all observers and all categories:
with reports = 1.006 secs.
without reports = 1.000 secs.

TABLE III

TEMPORAL COURSE OF THE REACTION-TIMES

Large type shows in seconds the average reaction-time for each category and each observer in successive periods which consist of 25 series each. These periods are indicated by I, II, III, and IV. The last period for every observer but R includes less than 25 series (see text).

Small type shows the number of cases upon which each reaction-time is based.

Obs.			g	g?	g=	g.nd	nd	nd=	=?	=	nd. l	=l	l?	l	?
F	I	Cases	60		1		4	1		41			4	52	6
		Time	1.62		1.68		3.20	3.00		2.06			1.66	1.14	2.72
	II	Cases	41			1				14				44	
		Time	1.00			16.00				1.60				.92	
Bo	I	Cases	52	4					5	53			3	25	1
		Time	.94	.68					1.08	1.04			.76	.92	1.24
	II	Cases	73						2	87				52	1
		Time	.74						.48	.86				.72	.66
	III	Cases	57							97				44	
		Time	.76							.82				.78	
	IV	Cases	6							14				4	
		Time	.54							.74				.60	
Bi	I	Cases	21		3	1				20		5		42	6
		Time	.78		1.00	.60				.72		.82		.74	1.02
	II	Cases	38		11					60		7		61	3
		Time	.60		.66					.70		.70		.60	.78
	III	Cases	34		12					43		14		69	5
		Time	.62		.78					.74		1.30		.64	1.12
	IV	Cases	30		8					38		6		38	2
		Time	.70		.86					.92		.92		.58	.64
R	I	Cases	20			8	31	10		23	12			36	1
		Time	1.40			2.02	1.44	1.68		1.28	1.40			1.20	1.00
	II	Cases	27	1		12	42	13		46	13			31	
		Time	.98	1.44		1.34	1.32	1.64		1.18	1.28			.98	
	III	Cases	39			18	47	8		24	8	2		40	
		Time	1.00			1.14	1.26	1.20		1.00	1.04	.96		.88	
	IV	Cases	42			17	64	8		20	16			41	
		Time	.88			1.12	1.06	1.18		1.00	1.04			.84	
E	I	Cases	59		14					24		8		20	
		Time	1.02		1.20					1.06		1.36		1.10	
	II	Cases	50		21					48		9	1	11	1
		Time	.98		1.36					1.18		1.44	1.20	1.10	1.52
	III	Cases	64		62					54		75		11	
		Time	1.28		1.24					1.08		1.50		1.00	

	Period	No. cases	Av. time
All observers and all categories...	I	676	1.23
	II	821	.94
	III	674	.87
	IV	354	.90

TABLE IV

Frequency of Categories

Figures show the number of cases in which each category was used by each observer, and total distribution of the categories in numbers and per cents.

	g	g?	g=	g.nd	nd	nd=	=?	=	nd. l	=l	l?	l	?
F	145		2	2	5	1		82	1	1	5	126	7
Bo	207	4					12	317			7	169	2
Bi	171	1	43	2	1		2	223		49	1	284	22
R	179		2	66	219	45		132	53	2		169	1
E	207	1	74				1	203		33	2	61	2
Total	909	6	121	70	225	46	15	957	54	85	15	809	34
%	27.2	0.2	3.6	2.1	6.8	1.4	0.4	28.6	1.6	2.5	0.4	24.2	1.0

TABLE V

Average Reaction-times for the Different Categories of Judgment

Figures show average reaction-time for each category and each observer, its M.V., and the number of cases upon which it is based. The general average at the bottom of the table is an average of all cases under each category, irrespective of the observer who gave the category.

Obs.		g	g?	g=	g.nd	nd	nd=	=?	=	nd. l	=l	l?	l	?
F	Cases	101		1	1	4	1		55			4	96	6
	Time	1.38		1.68	16.00	3.20	3.00		1.94			1.66	1.04	2.72
	M. V.	.59		0	0	1.09	0		.62			.14	.40	.52
Bo	Cases	188	4					7	251			3	125	2
	Time	.80	.68					.90	.88			76	.78	.94
	M. V.	.19	.21					.30	.18			.17	.16	.28
Bi	Cases	124		34	1				161		33		210	16
	Time	.66		.78	.60				.78		.78		.68	.96
	M. V.	.16		.18	0				.19		.15		.18	.35
R	Cases	128			55	184	39		113	49	2		148	1
	Time	1.02			1.30	1.26	1.46		1.12	1.20	.96		.96	1.00
	M. V.	.23			.33	.28	.30		.21	.25	.18		.22	0
E	Cases	156	1	45					113		23	1	42	1
	Time	1.00	1.44	1.28					1.12		1.28	1.20	1.08	1.52
	M. V.	.22	0	.13					.22		.19	0	.26	0
All	Cases	697	5	80	57	188	40	7	693	49	56	8	621	26
	Time	.94	.84	1.08	1.44	1.30	1.50	.90	1.02	1.20	1.02	1.28	.84	1.40

TABLE VI

ORDER OF CATEGORIES WITH RESPECT TO REACTION-TIMES

Table shows in seconds the average reaction-times, computed irrespective of the observers and corrected for their individual differences in time (see text); also the number of cases upon which each average is based.

Category of judgment	Number of cases	Average Reaction-time
l	621	.878
g?	5	.918
g	697	.922
l?	8	1.037
nd.l	49	1.049
=?	7	1.080
=	693	1.098
nd	188	1.123
g=	80	1.125
=l	56	1.143
nd=	40	1.297
g.nd	57	1.300
?	26	1.410

the different observers furnish relatively different numbers of cases in different categories. Since the observers exhibited great general differences in time of response (Table I), the averages depend to some extent upon the number of instances furnished by a given observer under a given category. The difficulty is overcome in Table VI, where corrected average reaction-times are shown for the categories. The correction was made by multiplying each time by the ratio of the average time of the observer in question to the average time of all observers for all categories (*viz.*, 1.00 sec.). *E. g.*, since F's av. time is 1.50 sec., his times were corrected by multiplying each by the ratio, $\frac{1.00}{1.50}$ (see Table I for the times). Then these corrected times were averaged and arranged in the rank order of Table VI.

The Qualitative Study of the Categories of Judgment

In the discussion which follows each quotation from the reports of the observers is prefaced (*a*) by the symbol designating the observer, (*b*) by a number which stands for the number of the series under the final instruction from which the quotation is taken, and usually (*c*) by a word (*e. g.*, 'greater') which indicates the judgment. When the observer's remarks are general, (*c*) is sometimes omitted.

General Adjustment of the Observers to the Conditions of the Experiment.—The interpretation of the instructions gave, in general, some difficulty. Especially were the observers uncertain of the meaning of the term *attitude*. Bo and R complained that they were not necessarily aware of their attitudes, and that they could therefore not be expected always to report them.

Bo, 9. "I still do not know what a reportable attitude is. I feel sure what some such attitudes are: as doubt or expectation, but I can't tell whether some of these other factors which characterize the experience are attitudinal in the sense of the experiment or not."

Bo, 63. "I can't report expectation as a shift in attitude, because I can inhibit the conscious part of it and voluntarily take up a practically neutral set; but whenever I give 'equal' under such conditions I wonder if there wasn't some unconscious set or attitude which determined it."

Bo, 68. "I can't report this suspected expectation as a shift of attitude simply because it isn't generally conscious. I suspect it merely because I am often surprised when I get *equal* at the beginning and 'greater' at the end of a series."

R, 74. "There was a feeling of uncertainty, which has not been previously present. There was no change of attitude. I don't know what a change of attitude is, or that I ever experienced one in this whole experiment."

Bi showed particular difficulty in adapting himself to the experimental conditions. He was troubled throughout by the instructions and easily disturbed by chance distractions.

Bi, 18. "I can't make out the meaning of your *receptive attitude kept constant*. If *attitude* means my intention, the thing I try to do, then my receptive attitude is constant. If it means more than that, such a thing as my intention in addition to my attentive set, then it is not constant. I can't keep myself the same; distractions are always different. If it means that a graded series of external conditions is to be paralleled by a graded series of bodily, subjective attitudes, then I don't know whether my attitude is constant or not; I think it is not."

F and, to a less extent, E found difficulty in making the required abstraction to the attribute under consideration (intensity, since they judged the sounds). F, as compared with the other observers, tended toward a reflective and less immediate type of judgment, an attitude which might easily facili-

tate a focusing upon other attributes of the stimulus. Undoubtedly the mediate judgment occurs more readily when the presentation is successive (*i. e.* with sounds; F, Bi, and E) than when it is simultaneous (*i. e.* with the lines; Bo and R). In the former case the observer frequently tries to retain the first member either in imagery or in some other surrogate conscious process until the second member appears; or else the second member is consciously anticipated. Of the three observers who worked with successive presentation, the two giving the longer times (F, 1.50 sec. on the average; E, 1.10 sec.) had difficulty in making the abstraction to intensity. The average times for the two modes of presentation (averages of all cases, not of observers) are practically identical (1.008 and 1.001 sec.), because Bi gave immediate judgments with successive presentation. (Bi's av. time, 0.72 sec., was shortest of all.)

F, 11. "There *was* a difference between the two sounds. I hesitated; I wasn't sure whether the difference was one of intensity or not; made up my mind that there wasn't any difference and said *equal* without, therefore, great assurance. I was struck, not with the *equal* of them in intensity, but with their difference as sounds. Perhaps I should have said *no-difference*, but since I did decide that their difference wasn't a difference in intensity and since I was set to judge intensity, I naturally said *equal*."

F, 17. "I keep saying *intensity* to myself. In spite of these repeated instructions to myself, the sound as a whole very often catches my attention, so that the first impression is sometimes different, and I have afterward to make up my mind about the intensity."

Many similar passages occur in F's reports up to the end of the experiment.

E, 20. "They seem so different that I couldn't seem to compare them. I suppose I mean by that that their differences impressed me so that I couldn't catch the difference in intensity if there was any. They are qualitatively different in some way that I can't describe." . . . "Seemed as if I were reading something else into the experience besides intensity: I don't think it was tone, but I'm not sure that it wasn't vaguely that. The second seemed to go up."

Doubtful Judgments.—In 34 cases (1% of the total number) the observers reported *doubtful* or *don't know*. Two-thirds of these judgments were given by Bi (22 cases: Table IV), who experienced especial difficulty in adapting himself to the experimental conditions. The judgment was usually recognized as a failure of the instruction. The most frequent cause assigned was a 'lapse of attention.' It is obvious that a state of absolute doubt reflects a shift in the psychophysical conditions which violates the assumptions of the method; such judgments must either be ruled out or discarded, as, indeed, it is customary to do.

In some cases the observers pointed out that an absolute doubtfulness represents a change of attitude:

Bo, 31. "That is a miscarriage completely. Everything was normal up to the time that I took my lips off the key; then I discovered to my surprise that I had no judgment ready. I had to look back, was very much disturbed, couldn't make up my mind, and said *doubtful*. The course at first seemed normal, but I think that the failure of the judgment to come out automatically must have meant that my attitude had not been normal, that it had changed unconsciously."

Bi, 16. "I was wondering about the standard when the variable came; that is why I said *doubtful*. I didn't know much about the variable. This is a different receptive attitude, an active one. The attitude I am trying to keep constant is receptive passivity."

In 36 cases (again about 1%: Table IV) the observers gave other categories of judgments *as* doubtful, that is to say, they reported *greater doubtful, equal doubtful,* or *less doubtful*. In a very great many more cases their reports show that they were doubtful, although the judgment was not given as doubtful. It is not possible, however, to treat this second class of doubtfuls statistically, because no sharp line of division can be established. The judgments were given as 'doubtful,' 'probably doubtful,' possibly doubtful,' 'hesitant but probably not doubtful,' 'delayed and therefore doubtful,' 'delayed but not doubtful,' and so on. The relation of hesitancy to doubt we shall take up later.

Bo, 1, greater-doubtful. "Started to say *greater*, at least I know my vocal-motor apparatus started to say something, and I took it to be *greater*. Somehow that incipient utterance did not seem to follow from presentation of lines. I looked at left line, then right again; saw right as longer. Moment of hesitation; then I said *greater* (possibly my vocal-motor apparatus was going to say something anyhow) and added doubtful as a sort of compromise."

Bo, 2, less-doubtful. "First pair seen together as equal. Then right line got less, without getting more distinct; then it seemed to change to an extent between less and equal. I was all set by that time to say less, and as the right seemed to waver slightly between less and the intermediate point, I said *less-doubtful*."

Bo, 7, equal-doubtful. "Rapidly shifting consciousness. First the left line, then the right as equal. Then left, then right, with left as less. Then left, then right, with left at first as equal (a pair); then rapidly changing to less, and then to a doubtful length, *i. e.*, visual extent actually hazy and inclined to waver. . . . A compromise with the equal grew out of the final wavering." Equal-doubtful: "Not a fair judgment, since *equal-doubtful* means I don't know whether it is equal or greater or perhaps less, and therefore it is not a serial judgment, since it does not lie upon one side or the other of equal."

E, 51, less-I-think. "I wasn't perfectly sure of it. It simply put me into the doubtful attitude."

It is clear from the reports that the observers recognized

that these mixed doubtful judgments constituted a violation of the constant attitude required by the instructions.

Bo, 10, equal. "A little doubt after I started to say *equal*. Up to that point the course was normal" [*i. e.*, showed a constant attitude].

Bo, 60, equal. "Normal so far as my tentative judgment, but just as I started to say *equal* there was a catch in my throat and I was thrown into an attitude of doubt. Then the judgment *equal* came on out automatically."

Bi, 53, equal. "Or less. I don't quite know why I was doubtful, or why there were two probable values for the judgment. I think my attention slipped; I don't know just where this slip came."

We must note that there has as yet been no conclusive evidence of a serial position of any *doubtful* category. We can not say that doubt lies here or there in the series of impressions. That the mixed doubtfuls occupy intermediate positions between the positive categories might be argued at this juncture; we must, however, defer discussion of the point until we have considered the 'or-judgments.'

Bi, 63, equal. "Wanted to say *equal*, but that wasn't enough. It may be a *doubtful-equal*, but I don't think I know what that means. Experience largely visual. The variable left me with a gray spot in a visual field, with a dark hole besides. That hole seemed to be the *doubtful*, a blankness as at first." Bi has elsewhere tended to correlate the experience of 'blankness' with the attitude of doubt.

Bi, 85, less. "But I am doubtful. My attitude was pretty bad, particularly at the time the standard was given."

R, 11, less. "Along towards the end of the exposure, there occurred this same kinaesthetic reaction which carried the meaning *less*. But there was also a slight doubtfulness, which seemed to be an organic or kinaesthetic thing. It seemed to have inhibited or delayed the report. This doubtful feeling carries a sort of meaning or set not to report the judgment because it isn't right. This feeling disappeared quickly and then the report came." A positive case of the violation of constant psychophysical conditions by the attitude of doubt!

R, 22, less. "There was a baffled, puzzled feeling, which also seemed to be a kinaesthetic thing of the same nature as strain. It is the sort of thing that makes a doubtful judgment, although it wasn't prominent enough in this case to call the judgment a really doubtful one."

E, 5, less. "I didn't feel satisfied with this one. It might have been *equal*. I don't seem to know anything more about it. The judgment just comes. Sometimes I am satisfied with it and sometimes not."

E, 56, equal. "Both seemed *equal*, I think." Less: "I felt perfectly sure of judgment." Equal: "Didn't feel very certain about it." Equal: "Perfectly satisfactory and normal;" thus E implies that doubt is unsatisfactory and not normal. Equal: "Didn't feel as sure of that as of last." Many other passages in E's reports are similar to these.

The case against the *doubtful* judgments is substantiated by the quantitative results.

In the first place, the *doubtful* judgments are the least frequent of all the categories used (see Table IV). Beginning with the least frequent category, the rank order is as follows: greater-doubtful (0.2%), equal-doubtful (0.4%), less-doubtful (0.4%), doubtful (1.0%), and then on through the 'or-judgments' and the judgment 'no-difference' to less (24.2%), greater (27.2%), and equal (28.6%). It appears that the most infrequent categories might well be those against which the instruction to maintain a constant attitude had operated.

Furthermore, the *doubtful* judgments tend to drop out as practice progresses, as if with the firmer establishment of the constant attitude (see Table III). In the first 25 series 4.4% of the judgments with times are doubtful judgments; in the second 25 series, but 1.1%; in the third 25, 0.7%; and the last group of series, 0.6%.

The reaction-times furnish some evidence (see Table VI). The average time for the judgment *doubtful* (1.41 sec.) is longer than for any other category, and very much longer than the times for the *less* (0.88 sec.), the *greater* (0.92 sec.), and the *equal* (1.10 sec.). (It will be shown presently that the other and intermediate categories are closely related to the *doubtful* judgment.) These long reaction-times doubtless indicate that the judgment *doubtful* is of the reflective type; that it is given less immediately and as the result of a more complicated mechanism than are the positive judgments; and that it is, in so far as it breaks away from the simple correlating mechanism which the psychophysical procedure demands, inadmissible.

The mixed doubtful judgments, 'greater-doubtful,' 'less-doubtful,' and 'equal-doubtful,' do not appear to be given after longer times than their corresponding positive judgments (see Table VI). They are perhaps based upon too few cases (5, 8, and 7 respectively) to be representative. The values are, however, not unexpected. The positive judgments (greater, less, equal) include many reflective cases, many doubtful cases, and many cases in which doubt occurred immediately after the utterance of the judgment. The mixed doubtful cases include doubtful cases and some cases in which doubt appeared just as the utterance was being initiated and was added in the spoken judgment. The two classes of categories are, therefore, not so different as might at first appear. We have already noted that it was impossible to draw a sharp line of division, and to separate in the statistical treatment the really positive judgments from those for which positive categories were employed, but which were shown by the reports to have been more or less doubtful.

Extra-Serial Attitudes Other Than Doubt.—The observers tended to meet the difficult instruction with a complex response. This complexity was especially evident in the early series, before the judgments had become as nearly mechanised as they were later, and in the judgments of the more 'reflective' observers who did not under practice develop the immediate type of response. The following report of F is a case in point:

F, 6, greater. "Before the experiment I told myself to get into an attitude to keep constant, *i. e.* not to be too expectant that the second sound would be greater, but to set myself more or less as if this were an experiment in right and wrong cases. The first sound was heard clearly and remained in a kind of memory-after-image, or in a kind of steady intensity of strain which meant that I was holding on to it. Then the second sound was heard clearly as louder than the first, and immediately I said *greater*. Then relief. I was very certain of my judgment. I should say that the first sound is actively attended to. I expected it and held it after it had come. The second sound I hear more passively."

Here we have hints of many possible failures of a 'constant receptive attitude.' In the course of one judgment mention is made of expectation, relief, certainty, active attention, and passive reception. Do these states constitute attitudinal shifts which violate the instructions?

Fortunately for the experiment, the passage quoted may be regarded as an exception. All the observers, including F, tended under practice to acquire a greater constancy of attitude, which came about by way of a simplification of the mechanism of judgment. Bi, as we have already observed, alone failed to reach a sympathetic adjustment to the problem. Again and again he would be upset by distractions both within and without the experiment. The following report is typical of the more subtle form of disturbance to which he was subject:

Bi, 52, equal. "Conscious of time being longer between standard and variable. This is an observation of the duration of such strains as breathing strains, that gives me a different attitude than usual for my judgment."

Next to doubt, expectation constituted the most frequent mode of departure from what the observers styled the 'normal' attitude. Under expectation the observer expects something specific, some particular category of judgment or value of stimulus, and the thing expected naturally changes from observation to observation within a series: a change which is presupposed in the method of limits and, to a less extent, in the method of constant stimuli. Expectation becomes

therefore a particular enemy of the constant receptive attitude for the reason that it tends to be specific and to shift, not with the stimulus, but with the progress of the experiment.[6]

F, 8, equal. "My attitude that time was that I expected them to be near equal. The two came to me as equal; I went over them in imagery, still equal; so I said *equal.*" Greater: "Still expected them to be equal. Second came as a little louder."

F, 10, less (long reaction time; given after five judgments of greater). "I couldn't help expecting *greater* because there had been so many. The first sound struck me as being absolutely loud; a little surprise that the second one wasn't so loud; I hesitated, then said *less.*"

Bo, 11, less. "Same as before, except that I anticipated 'less' a little."

Bo, 35, greater. "I think that perhaps in my 'normal' attitude there is a little expectation of *greater,* and that *equal* partakes somewhat of the nature of a negative judgment, *i. e. equal* is *not-greater.* I should not say that the *equal* judgment is entirely defeated expectation, yet in one sense I think the *greater* judgment is the more expected. The thing is very subtle; it is hard to get at the expectation consciously; I should say it was generally unconscious. I just get hints of it once in a while, so that I can't be sure that it isn't there most of the time."

Bo, 45, equal. "I think I was a little disposed toward *equal* this time; I rather expected a series and that it was now about time to reach *equal.* I had misgivings about my judgment after I had made it."

Bi, 20, equal-or-greater. "After the signal I took the trouble to recall the previous pair. I think that made a difference in my judgment. It was harder for me to judge as I did because I had to get rid of this sort of expectation before I could judge the pair in its own right."

Bi, 23, equal. "Expected *equal* quite strongly. Standard was weak; that is why expectation was strong. My whole attitude seemed to shift when I found I was wrong on the standard."

Bi, 61, less. "I expected this less than it turned out to be. After I had said *less,* I felt quite positive that I might have said *equal* if I had been expecting *equal.*"

Bi, 73, less-or-equal. "It may be I expected an *equal,* but I really found it pretty positively less. After that I returned to *equal* as I reported it. I can't tell whether I said *equal* through the persistence of expectation, or whether the stimuli actually warranted *equal.*"

R, 75, greater. "I think there was a change in expectancy there, that is to say, you have been going along with serial judgments and I expected greater-or-no-difference in that region. I think I was set for such a judgment." "What I understand by attitude hasn't changed at all in the experiment, so far as I am aware. I have always put my judgments in the same serial categories, the attitude toward that has been constant. There have been, of course, changes in expectation, which I did not understand to be meant; so I didn't report them." R has still not thoroughly understood the instructions; his

[6] There can, of course, be constant expectations, which need not and can not be avoided. Such, for example, is the general expectation for 'equal or greater' or 'equal or less,' as the case may be, which was determined by the instruction for the two sorts of series.

report above indicates clearly enough that expectation meant a change of disposition toward the stimuli.

E, 16, equal-or-greater. "After the first sound a feeling that it was going to be all right now, that the next was going to be definitely less. When the second came it surprised me that it was as loud as it was." E gives many other reports of surprise which imply an expectancy. She does not explicitly characterize the attitude as a violation of the condition of constancy.

The general complaint of the observers, which we have pointed out above, namely, that attitudes may be unconscious and as such unreportable, is made specifically against expectation. The second quotation from Bo is relevant, as are also many from the reports of Bi:

Bi, 18, equal. "I intended to judge that one as something less than *equal,* though I didn't realize this intention until I had given the judgment. This amounts to an unconscious set suddenly becoming conscious, as if the previous judgment gave me an attitude for another like it. This attitude was unconscious, but when the stimuli seemed to demand the judgment *equal,* I seemed doubtful that it was *equal,* purely because I seemed to expect it to be like the preceding judgment. That is a shift of attitude, then. I don't know whether I have had expectations for other judgments or not, but I suppose I had. If I had they were unconscious."

Bi, 43, equal. "I expected that to be *greater.* It is again a case where the expectation does not become conscious until the variable is given."

Bi, 51, equal. "The feeling that the variable might be less even. Certainly I wasn't expecting *equal.* The *less* may have come from an unconsciously expected *greater.*" And many other similar passages.

Bi alone of all the observers suggests that expectation may sometimes not vitiate the required constant attitude. We have had plenty of evidence from Bi as well as from other observers that it also frequently does, enough evidence, in fact, to make us insist upon its exclusion.

Bi, 23, equal-or-less. "I certainly expected *greater,* but not until after the standard had come. I was indifferent up to that time. No struggle at all, however, as to which judgment was right; the expectation wasn't insistent. It didn't seem to modify the feeling I had toward the judgment any more than if it were breathing."

Bi, 63, less. "I expected *greater.* I didn't seem at all surprised that the variable should come as less, and I didn't notice that expectation modified my judgment at all. The expected variable seemed irrelevant to the judgment."

These two cases are the only two explicit mentions of the irrelevancy of expectancy to the problem made by any observer.

The serial mode of presentation of the stimulus pairs (modified method of limits) favored the occurrence of expectation, in spite of the attempt to keep the observers in ignorance of the method by the occasional interjection of irregular orders

of presentation. All the observers but E explicitly mention a shifting expectation that grew out of a suspicion that a method of limits was being followed. For example:

Bo, 35, greater. "A *greater*, I think, was expected. At least at the beginning of a series, which I expect in a somewhat serial order, I am inclined to expect *greater*. I am not sure that I do not therefore shift my attitude as the series continues by expecting *equal* more and *greater* less. The thing is very subtle; it is hard to get at consciously;" *etc.*

Bi, 59, equal (the second judgment in a series which began with *greater*). "Or less. I think I'll say 'or less' because I expected *greater* as I do at the beginning of a series."

On the basis of such observations it would be in order to raise the whole question of the propriety of the method of limits, which puts a premium upon a shifting expectation. In the method of constant stimuli the rule that the observer should be told when each new series is begun is also open to question. If the subject is to be kept constantly disposed for the whole series under investigation, it is surely not permissible to allow dispositional shifts within that series.

It is next in order for us to enquire what other attitudinal changes besides doubt and expectation are likely to interfere with the maintenance of a constant disposition.

Surprise is mentioned frequently, but it seems in most cases to reduce to a form, or at least a concomitant, of expectation.

Bi, 31, greater-or-equal. "I wasn't conscious of any expectation, yet it does look as if I expected it to be *greater*. The same thing has happened a number of times: I feel surprise after the judgment. It seems as if this surprise comes as an unconscious expectation or valuation of the variable."

E, 16, equal-or-greater. "The first sound surprised me by being so soft; and then the second when it came surprised me too. I had the notion it would be very soft, and it surprised me by being so loud."

Surprise may, however, appear to leave the judgment unaffected.

Bo, 23, greater. "My attitude, besides being 'normal,' was one of surprise, although the surprise seems somehow irrelevant to the judgment."

A report of a positive attitude of *certainty* is exceptional. The 'normal' attitude seems to have been passive, neither doubtful nor certain, although it is possible logically to interpret the immediacy of the 'normal' judgment as a form of unconscious certainty. In several of the few cases in which certainty was reported as an attitudinal change, it was reduced directly to surprise and indirectly to expectation:

Bo, 12, greater. "There was the degree of expectation which a conscious reference to the instructions has. I knew that I was under

a different *Aufgabe* from the 'less-or-equal' instruction. I was shocked by the line, *i. e.*, shock = surprise at bigness of line = certainty of judgment. I should say that this certainty, due to surprise, was a definite shift of attitude."

There are no other types of attitudinal shift which are reported with sufficient frequency and positiveness to merit separate discussion. All the observers suspected dispositional variations at times, but their suspicions were not confirmed. There are a good many isolated statements like the following:

Bo, 12, greater. "For the most part a mechanical judgment, but just at the end of the period, before the judgment, I was definitely struck by the bigness of the line. I suppose that is an attitudinal shift." (This judgment was less immediate and more 'reflective' than Bo's 'normal' judgment; hence we must return later to the case when we discuss the immediate judgment as the normal judgment.)

The 'Or-Judgments.'—The judgments 'greater-or-equal,' 'equal-or-less,' 'greater-or-no-difference,' 'no-difference-or-equal,' and 'no-difference-or-less' were given in 11.2% of all cases (see Table IV for the distribution). Bo gave no such judgments and F but seven, so that for the description of the 'or-judgment' we must look to the other three observers. Of these Bi gave 94 and E 107, which were practically all either 'greater-or-equal' or 'equal-or-less.' R used the category 'no-difference,' and practically all of his 168 'or-judgments' were the combinations of 'greater,' 'equal,' or 'less' with 'no-difference.'

The descriptions of the 'or-judgments' are of three kinds. (1) The 'or-judgment' may reflect a mixed basis of judgment or a conflict between bases; (2) it may be the outcome of an attitude of doubt; or (3) it may appear to constitute a serial category in its own right. The first case shades imperceptibly into the second, since conflict is apt to beget doubt. Of the validity of the third case we shall have presently to enquire.

Both Bi and R report many cases in which an 'or-judgment' results from a twofold basis of judgment or from a vacillation between two conditions of judgment.

Bi, 27, equal-or-greater. "When variable came I had two spots of light, about same size, corresponding to intensity. The sizes were the same. I think in terms of throat kinaesthesis and I am inclined to believe that the difference came in there. It was somehow as if visually they were equal and kinaesthetically they were different."

Bi, 41, equal-or-greater. "Don't know why, except that there seemed to be two values for the variable in relation to the standard."

Bi, 42, equal-or-less. "Judgments of that sort have double value, the values of the variable compared with two different probable values of the standard. I don't know where the two values come

from. Such judgments are carried visually sometimes. The value of the variable is a point; the value of the standard is a line or an area and sometimes approaches the dumb-bell of cutaneous perception; the two ends are the two values of the standard."

Bi, 69, equal-or-greater. "Thick and short vertical visual imagery, which stood for both. I don't know why I changed to *greater*. A case of succession. Apparently I had a spot higher up which stood for the *greater*, while the line stood for both *equal*."

R, 2, no-difference-or-greater. "In that case there seemed to be a vacillation of judgment. At first the two seemed equal, although I do not know in what terms this equality came to consciousness. Then came the idea that the right was greater. The new judgment seemed to be principally conditioned by a kinaesthetic reaction to the stimulus which carried over in imagery from the end of the stimulation. I don't think there was any visual image of the lines to condition this change. The change came so late that I reported *no-difference*. As near as I can tell the doubtfulness of the judgment consisted first in the fluctuations of the judgment and secondly in the absence of a feeling of sureness."

The equivalence to doubt of a fluctuation of alternate bases of judgment is still further emphasized in the following instances:

R, 4, no-difference-or-equal. "That was a distinctly doubtful judgment. The two ideas alternated, *i. e.* the two meanings carried in kinaesthetic terms."

R, 14, greater-or-no-difference. After describing two meanings, kinaesthetically carried, for the two terms of the judgment, R continues: "I think the two meanings alternated, but I am not sure of it. Over the whole judgment-consciousness there was a general feeling of uncertainty."

E, 51, equal-or-greater. "Very, very doubtful. I seemed to hesitate, to go from one judgment to the other. I couldn't make up my mind."

Occasionally expectation conditions an 'or-judgment;' there is conflict between an actual impression and an anticipated impression:

Bi, 37, equal-or-less. "I think *equal* was what I expected and *less* was what the variable seemed really to call out. It is the same kind of unconscious expectation that I mentioned before. What I did was to turn from what presumably would have been a *less* without the expectation into the class of *equal-or-less*."

Bi, 59, equal-or-less. "Not very positive of expectation for *greater*. It may be that the expectation gave the 'or-judgment.' The standard was completely lost in the expected variable, so that I judged the variable against a standard transformed into the expected variable."

E, 34, less-or-equal. "The second one startled me, it seemed so small. When I started to speak, however, the word *equal* was in my mind, so that I said *less-or-equal*. The thing really struggling to be said was *less*, but there seemed some doubt about it and I said *equal*."

Equivocally determined judgments like the foregoing are frequent; they do not, however, form the greater part of the

'or-judgments.' The great majority of the 'or-judgments' are definitely doubtful judgments.

F, 8, equal-or-no-difference. "Quite open-minded. The two sounds came to me as about equal; I went over them in imagery trying to see if I could tell what the difference was if there was any difference. Still felt doubtful whether there was any difference, so I said *equal-or-no-difference.*"

F, 27, greater-or-no-difference. "I wanted to say *greater-or-equal* instead of *greater-or-no-difference.* When the sound came I was immediately doubtful, as the second sound did not come as either different or not different; then it seemed to me a little greater; then it seemed equal; then I wanted to say *greater-or-equal.* Then I thought of my instructions [where 'no-difference' is suggested as a possible serial category] and it seemed to me as if *equal-or-greater* might not be in a serial line. Then it struck me that *greater-or-no-difference* satisfied the conditions pretty well, because, although the second sound did not come to me as positively not-different, neither did it come as positively different. I really think that *equal-or-greater* is my best judgment, for I think that it is serial." (An excellent example of the reflective type of judgment, so common with F!)

Bi, 18, less-or-equal. "I was awfully puzzled about that one. And while I was puzzled and waiting for some cue to come, everything looked intensely black. I don't think the blackness was important except that it was mixed with the hesitation."

Bi, 42, equal. "To say that that is *equal* is not saying enough. It is a *doubtful equal,* that is to say, what I call *equal-or-less.* Judgments of that sort have double values;" *etc.*

R, 8, less-or-no-difference. "The chief characteristic of that judgment was an organic feeling which meant uncertainty. I don't know why I knew the judgment was less."

R, 14, equal-or-no-difference: ". . . Also the feeling of uncertainty." Followed by *equal:* "This was different from the last one only in the absence of the feeling of uncertainty."

R, 26, less-or-no-difference. "The chief difference between this judgment and the last one [which was *less*] is the feeling of hesitancy which came in and prevented my reporting the feeling *less* which I had first. This hesitancy is a kinaesthetic thing and seems to be a sort of catching of my breath. The judgment practically amounts to a doubtful judgment of *less,* which, in order to express it in these terms [suggestion of the instruction?], makes me say *less-or-no-difference.*"

R, 40, equal-or-no-difference. "That was a very doubtful judgment. The whole judgment-consciousness was colored by a feeling of indecision, hesitancy, or doubtfulness."

R, 52, equal-or-no-difference. "This was a doubtful judgment. It seems to differ from the last one [a *less*] in so far as the meaning of the judgment seems to be held up and not to come. This holding-up or hesitancy seems to constitute the doubt and is the only difference between it and the straight judgment *less.*"

R, 77, less-or-no-difference. "The *no-difference* judgment really means doubt, which seems to be represented by the slowness of any judgment coming. I had the sensations from the two lines, before they meant either *equal* or *less.* As a result I gave the doubtful judgment. The judgment at first didn't mean anything; finally it did come to mean lessness a bit; the *no-difference* part is the *doubtful.*"

And so on in almost all of the later instances. R's identification of the 'or-judgment' with the doubtful judgment is practically absolute.

E, 1, greater. "I don't feel perfectly sure of that judgment; I really ought to have said *greater-or-equal*. It seems as if it were hard to find the difference."

E, 10, equal-or-greater. "Doubtful feeling about that."

E, 14, greater-or-equal. "Doubtful. . . . A feeling of dissatisfaction in not being able to find a clear cut difference."

E, 16, equal-or-greater: After describing a dual basis of judgment, E concludes: "It seemed to me first *greater*, then not; but there was right away an indecision about it. I simply couldn't feel sure whether it was equal or greater." Equal-or-greater: ". . . . It was a doubtful judgment; I wasn't sure of it at all."

E, 28, equal-or-greater. "There was no sureness about that at all. I think my impulse was to say *greater*, and immediately on top of that came *equal; equal* popped out, but still I wasn't satisfied with it and so added *greater*."

E, 51, equal-or-greater. "Very, very doubtful. I seemed to hesitate, to go from one to the other: I couldn't make up my mind."

There are many similar passages in E's reports, all of them indicating that the 'or-judgment' is a doubtful judgment. E does not explicitly identify the two, but seems to take the identity for granted. By implication she regards her 'or-judgments' as failures.

There is now little room for doubt that the 'or-judgment' indicates essentially an infringement upon the constant receptive attitude. Instead of being the expression of a particular impression, as the psychophysical procedure demands, it is a logical compromise between two incompatible impressions. The very existence of two rival impressions in the focus of attention implies a shift of attitude, which is definitely recognized in those cases where the alternate impression is the result of expectation. Usually psychophysical constancy is still further disturbed by the shift to an attitude of doubt. 'Or-judgments' of this character are plainly not allowable in psychophysical work.

But is there not, one may ask, a definite, positive, intermediate, serial impression which is neither, let us say, 'equal' nor 'greater,' and which corresponds to a judgment of 'equal-or-greater?' Bo, who gives no 'or-judgments,' and F, who gives but few, do not find it. R explicitly denies it, and E implicitly. Bi alone hints of the existence of such a category, and that in only three places:

Bi, 49, less or equal: "That seemed normal enough. That 'or' wasn't due to expectation. A case of very near *equal;* as soon as I'd said *less, equal* just followed and seemed just as good. It is just like that. I don't know how the *equal* followed upon the *less*." Equal-or-greater: "This was just like the one before, except that the judgment was different. It comes spontaneously, as far as I can see."

Bi, 59, equal-or-greater. "That was a case of good conditions, but the difference was so small that I couldn't make it out."

These, however, are but three cases in three hundred and seventy-six. Elsewhere Bi agrees with the other observers. It therefore seems that, even if there is a definite serial impression corresponding to the 'or-judgment,' it is not indispensable; whereas the undiscriminating admission of the 'or-categories' in a psychophysical group is almost certain to destroy the serial nature of the group.

Finally we must add the statistical evidence. The 'or-judgments' do not tend to drop out under practice (Table III), but they are avoided under the instruction by the two most experienced observers, F and Bo. Consequently they constitute, after the doubtful judgments, the smallest categorical groups (Table IV). (The order, after the doubtful judgments, beginning with the least, is: 'no-difference-or-equal,' 'no-difference-or-less,' 'greater-or-no-difference,' 'equal-or-less,' 'greater-or-equal.') All five categories together form a group which is less than half the size of the group for 'less' or 'greater' or 'equal.' The infrequency of the 'or-judgment' argues that it may be dispensed with.

In general, the reaction-times for the 'or-judgments' are intermediate between the times for 'doubtful' and the times for the positive judgments, 'greater,' 'equal' and 'less.' Four of the five 'or-judgments' lie in the order of categories immediately below 'doubtful' (see Table VI). The average reaction-time of the five 'or-categories' is 1.17 sec.; of the three positive categories, .96 sec. It appears, then, as if the ambiguous and doubtful nature of the 'or-judgments' resulted in the lengthening of their reaction-times.

The Judgment 'No-Difference.'—The category 'no-difference' was employed almost exclusively by R (225 times). F used it five times, Bi once, Bo and E not at all.

As with the 'or-judgments,' so here we can find some slight evidence that 'no-difference' is a positive category.

R, 33, no-difference: "This was more like the *less* judgments. No particular doubtfulness on it; simply a different kinaesthesis that means a *no-difference* judgment." Later, *equal* following a *no-difference:* "The condition of change from the last judgment seems to be the presence of what I might describe as a positive feeling of equality; it is kinaesthetic and different from the general feel of the *no-difference* judgment. On the side of meaning it is quite different, for *equal* means that the two extents are actually the same, while *no-difference* simply means that they are so nearly the same that I can not tell which way the difference lies, if there is one."

R, 50, no-difference (following many series in which *no-difference* has been equated to *doubt*): "The judgment-category *no-difference* seems to be taking on a meaning of its own, apart from the doubtfulness which has been associated with it. The whole consciousness is simplifying. Instead of a *no-difference* judgment being indecision

between *greater* and *equal*, as it was in the preceding case, for instance, it is now as definite a judgment as *greater* or *equal* would be." But R never repeats this observation, and in Series 53. and repeatedly thereafter we find him again identifying *no-difference* with *doubtful*.

F, 2, greater. "I don't think I meant to say *greater* at all. . . . I really should have said *not different*. They were not different; not that there was no difference. When I say that there is definitely *no difference* I mean that there has been a true comparison, a true comparative attitude. *No-difference* seems positive. This was scarcely a real judgment, scarcely a comparison." This in Series 2; but F finds occasion to judge *no-difference* only five times in 377, and ceases entirely to use the category after Series 16.

Like F, Bi hints at a *no-difference* impression without using the category.

Bi, 70, equal. "Was distracted. Think I said *equal* because I couldn't find any difference,—a quite different experience from saying *equal* because they are equal."

Bi, 73, equal. "I said *equal* because I couldn't find any difference. I had a feeling that it shouldn't be *equal*, that expectation gave me the feeling to say *equal* because I couldn't find any difference."

We could make out a case against the 'no-difference' judgment on the basis of these positive instances alone. The category is used extensively by only one observer (R) among five; the other observers who use it (F, Bi) do so only in the early series; its identification as a positive category is exceptional, for no observer maintains this opinion for any length of time; R gives the most definite evidence (see above) that 'no-difference' is a positive category, but he also gives the most evidence (see below) that it usually is not; in the first two of R's three instances (see above) he admits that he was judging kinaesthetic surrogates and not the visual extents; in R's second instance above 'no-difference' appears to be a broad category lying neither to the one side nor to the other of 'equal,' and as such it is extra-serial and consequently taboo under the instructions; and finally R (second quotation) and Bi (both quotations) imply that 'no-difference' is really after all, not a positive, but a negative judgment, that it represents a failure to find either a positive difference or a positive equality, and thus, by implication, that it stands for a dispositional shift from a positive receptive attitude to a negative or defeated receptive attitude.

We have decided against the 'no-difference' category because of the insufficiency of its credentials. Now let us see what the direct evidence against it is, that is to say, how definitely it can be identified with doubt. For this category R is, as we have said, the important observer.

R, 2, no-difference. "The judgment showed no oscillation from one category to another as did the last one [an 'or-judgment'], but it was by no means sure."

R, 4, no-difference. "There was a feeling of doubt which made me say *no-difference* instead of *equal*."

R, 8, no-difference. "The first thing that I experienced toward the end of the exposure was a feeling of uncertainty. I was aware that I had no feeling of *greater* or *less*, and gave the report."

R, 11, no-difference. "The total consciousness there seems to be one of questioning or doubt, that is to say, I can find no difference between the two extents and this fits logically with the *no-difference* judgment."

R, 22, no-difference. "Here the prominent thing in the judgment is this feeling of 'puzzled' or 'baffled,' for the judgment *no-difference* as I gave it only amounts to a doubtful judgment. It seems due to a lack of prompt reaction which means a definite judgment such as *equal* or *less*."

R, 26, no-difference. "This was really a *doubtful equal* judgment. The general kinaesthetic set which means *equal* was present, but there was also a feeding of hesitancy."

R, 27, no-difference. "This was a typically *doubtful* judgment, *i. e.*, the predominant thing in consciousness was the hesitancy. The kinaesthesis which carried the meaning of a definite judgment seems to have dropped out. The feeling of hesitancy seems to be coming to mean a judgment of *no-difference*. *No-difference* is a report for the typically uncertain judgment or doubtful judgment. In the case of a *no-difference* with another judgment, as 'no-difference-or-less,' the *no-difference* comes to mean that I am not confident of the other judgment."

This kind of report is made again and again with too little variation to warrant frequent quotation. We have already noted that R departed from the interpretation of 'no-difference' as hesitation or doubt in Series 33 and 50. After each departure, however, he comes back to the old description. A few more samples, selected at wide intervals, will suffice.

R, 50, no-difference, given just before the 'no-difference' judgment quoted above in which R asserted the positive character of the 'no-difference' category, and just after a 'greater' judgment: "This differs from the preceding in the presence of a feeling of uneasiness, which means uncertainty in the judgment."

R, 53, no-difference. "This judgment is of the general character of doubt. There was kinaesthesis present which meant doubt. The preceding judgment [a *less*], unlike this one, seemed to come automatically." Equal, after a 'no-difference': "The general kinaesthetic feeling which carried a meaning of doubt or uncertainty disappeared."

R, 69, no-difference. "This is a typical uncertain judgment. A kinaesthetic feeling carried the meaning of uncertainty, or, as it is now coming to be, the meaning of *no-difference*. This kinaesthesis means *no-difference* directly, though I can see that it means doubtfulness also."

R, 77, no-difference. "Here even more typically doubtful judgment than the last [an 'or-judgment'], though the uncertainty was a kinaesthetic thing, a sort of tingling kinaesthesis in the chest which means uncertainty. For such a thing I use the category *no-difference*."

R, 91, no-difference. "Now this kinaesthesis, which carries the meaning of uncertainty, has become the most prominent thing in consciousness. It now seems to carry the whole meaning of the judgment, whereas before it just seemed to come in as something additional."

We can also quote Bi on the equivalence of 'no-difference' to doubt.

Bi, 15, greater-or-no-difference. "First the stimulus meant *greater;* then came a feeling of doubt and the thing meant *no-difference.* The whole experience was colored by doubt." No-difference: "The experience in the *no-difference* judgment is essentially an experience of doubt. Considered logically the stimuli are neither equal nor different. Kinaesthesis carried the meaning of uncertainty." We may guess that Bi recognized here that the judgment 'no-difference' violated the instructions, and that for this reason he never gave it again.

F was inclined in the early series, where he used the 'no-difference' category, to equate it to a particular kind of doubt.

F, 8, equal-or-no-difference. ". . . *No-difference* means no difference in intensity here. I wanted to say *doubtful,* and stopped myself from saying it because I wasn't entirely doubtful. *Doubtful* would have meant, 'I don't know anything about it.'"
F. 17. "I very often find trouble and sometimes have to give a *no-difference* judgment."

In the face of all this evidence it is impossible that we should admit the category of 'no-difference' in psychophysical procedure any more than we admit the doubtful categories. Four of the observers by their avoidance of 'no-difference' showed that the instruction tended to exclude the term, even in spite of the fact that it was explicitly suggested in the instruction. With R the suggestion of the use of the term in the instruction worked, although in working it did violence to the operation of the major purpose of the instruction (the maintenance of a constant, receptive attitude), as his reports abundantly show.

The reaction-times for the 'no-difference' judgments are on the average intermediate between the times for the 'or-judgments' and the times for the positive judgments and nearer the former, suggesting that 'no-difference' is a slightly more immediate kind of doubt than are the 'or-judgments.' (See Table VI. The av. times are: Positive judgments, 0.96 sec.; 'no-difference,' 1.12 sec.; 'or-judgments,' 1.17 sec.).

The Judgments 'Greater,' 'Equal,' and 'Less.'—We have disposed successively of the doubtful judgments, the 'or-judgments,' and the judgment 'no-difference' on the ground that they can not ordinarily be given under a constant serial psychophysical disposition. We are left with the categories 'greater,' 'equal,' and 'less;' and it now behooves us to enquire into the nature of these remaining forms of judgment. It is logically conceivable that 'greater' and 'equal,' for instance, are not serially related, that a change from the one

category to the other involves an extra-serial change in attitude, and that, as a consequence, psychophysical correlation becomes an impossibility. We are assured, however, by the observers that the contrary is the case; in broad general terms, at least, the judgments 'greater,' 'equal,' and 'less' are equivalents belonging to the same order, an order to which the doubtful judgment, in all the forms in which we have met it, does not belong.

F, 2, greater: "Just like my other judgments." Equal: "Just as usual. Judgment automatically says itself." That is to say, F reports no difference between 'greater' and 'equal.'

F, 6, greater, following an 'equal': "Just exactly like last experiment, only I said 'greater,' automatically. That it sounded greater is all I can say."

F, 40, greater: "No hesitation; both sounds tremendously clear; nothing else new." Equal: "Same." Equal: "Same." Less: "Nothing new; just a little surprise."

Bo, 9, equal, after a 'greater': "Mechanical judgment like the last."

Bo, 14, greater, after an 'equal': "I can't see that there was any change of attitude from the preceding judgment to this one of 'greater.' . . . If the change in the situation is a change in attitude, it is at least not the definite change which I understand by attitude, such as a change to surprise, expectation, certainty, and so forth."

Bo, 17, equal, after a 'greater': "I don't think I can find any difference of conditions of judgment there. The 'equal' came out just as mechanically as the previous 'greaters' have done. I wasn't even aware that I was giving a different judgment until after I had given it. As far as attitude or conscious conditions go, the last two trials seem to me practically identical." Less: "Some delay. . . . *Less* came as mechanically and immediately as the *greaters* and *equals* have. It did not seem to be dependent on the delay, although the delay is doubtless dependent on the lessness of the difference. I do not now see any difference between the necessary conditions of *greater, equal,* or *less.*"

Bo, 20, less, after two 'equals': "I shouldn't say there was any gross shift of attitude from the last two times. The conditions for *less* appeared to lie absolutely in the visual impression. I see the lines and I say the judgment; that is about all it seems to be."

Bo, 22, equal. "There I had a change of judgment from *less* to *equal* that did not mean, I should say, a change of attitude. I was passive, attentively disposed, not doubtful at any time. I just made the first judgment and then changed it without the doubt or hesitation that I should call an attitude of uncertainty."

Bo, 26, equal. "Normal although I changed from *less* to *equal.* The judgment was normal in spite of the change because the change wasn't a change in my attitude but a change in the length of the lines—I saw the right hand line grow. I was not even disturbed by the change at the time, although afterward I was doubtful."

Bo, 31, equal, after a 'greater': ". . . I was surprised to find that I had changed the category so easily, practically without realizing it."

Bo, 39, equal, after seven 'greaters': "Normal. . . . I think this time my attitude was just the same when I gave *equal* as *greater.*

. . . I should say the visual appearance of the extents was the condition of change."

Bo, 41, equal, after five 'lesses': "I can't see that there is any change in the conditions of judgment. This time was just like last time."

Bo, 52, equal, after four 'greaters': "Normal. Entirely like last judgment in spite of the change of category."

Bo, 55, equal, after six 'greaters': "Normal. I haven't the least idea what made me change my judgment. The whole thing runs off like the very smoothest habit."

The foregoing are but a few excerpts from a great number of long reports made by Bo, all with the same import. Bo continued to seek vainly for the conditions of change between these three categories, and could find in general only the visual impression, which he could not regard as attitudinal. He was continually troubled by his belief that an attitude is essentially a nervous affair and may normally be unconscious and unreportable.

Bi, 15, greater, after an 'equal': "The same kinaesthetic experience meant *greater*." Equal: "The equality judgment is in many ways like the *greater* judgment. It has none of the feeling of doubt or hesitancy; the general pattern of the experience is the same, save that the predominant kinaesthesis which carries the meaning is different. Instead of the chest kinaesthesis of *greater*, I have kinaesthesis in the upper chest or neck which means *equal* and is practically all there is to the equalness of the experience."

Bi, 40, less, after an 'equal': "This was the same type as the one I just had."

R, 2, greater, after an 'equal': "The only condition of change which I can find is the change in the relation between the two stimuli."

R, 25, less, after a 'less': "No change from last at all." Then equal: "The only condition I can find for the change is the difference in the stimulus and the sensation." Then less: "Just the same kind of difference between the two categories." Then less: "No change at all." Then greater: "The condition of change from one category to another was only a change in the sensation that gave rise to the judgment." Then equal: "Same conditions of change as reported last time."

R, 61, less, after an 'equal': "The only condition of change is a change in the stimulus. Both are so automatic that there is nothing conscious in them to change."

On several other occasions R made reports which are almost identical with this last one.

The category 'equal' appears to be more equivocal than the categories 'greater' and 'less.' On the one hand, 'equal' does constitute a positive category, comparable to 'greater' or 'less.'

F, 17, equal. "Second sound came as identical with the first." And thereafter F used the term *identical* to represent this special kind of *equal*.

R, 4, equal. "The feeling that the two lines were equal came quickly. It was a kinaesthetic image which definitely carried the meaning *equal*."

R, 58, equal. "The kinaesthetic feeling of *equal* came in."

R, 77, equal. "A typically different form of judgment [from 'no-

difference']. Instead of the kinaesthetic feeling of uncertainty, I know these things to be equal as if there were *equal* in them."

On the other hand, the 'equal' judgment is sometimes a doubtful judgment:

R, 40, equal. "The *equal* judgments seem to possess a little of a doubtful character. I am not as confident of them as I am of the *greater* or *less* judgments."

Other observers hint at the doubt. It appears that sometimes 'equal' is given when the judgment should have been 'greater-or-less,' a typical doubtful judgment of the 'or' type. It should be remembered further that the range of equality is limited in both directions, and that it is therefore impossible to have as striking cases of positive equality as it is of positive greaterness or lessness. Between the equality which is doubt and positive equality there are degrees of hesitation which can not always be classed as doubt:

F, 18, equal. "There are degrees of definiteness of *equal*, I think. At least I am more certain of my *equal* judgments when there is identity than when there is not."

F, 28, equal. "They were nearer identical (not absolutely identical) than the last *equal*."

F, 36. "There are two kinds of *equal* judgments. There is identity where you automatically say *equal*; organic relief and an immediate judgment. Then there is the *equal* judgment which comes when you are struck by the difference of the two, but when you don't know whether they are different in intensity or in something else."

We should, therefore, keep explicitly in mind that the equivalence of the 'equal' judgment to the 'greater' and the 'less,' an equivalence which the reports attest, can probably be stated only of the positive judgment of 'equal.' There is a more or less doubtful judgment, which is sometimes masked by the term 'equal,' and which must be excluded with the other doubtful judgments.

The reaction-times for the three positive categories (Table VI; less = 0.88 sec., greater = 0.92 sec., equal = 1.10 sec.) are less than the times for any of the doubtful categories (except the mixed doubtfuls). The long time for 'equal' is probably due to the inclusion of a number of 'doubtful equals.' Hence the difference in time between the positive categories and the doubtful categories is in reality greater than here appears.

Variations Within the Serial Attitude.—We have dealt with the categories 'greater,' 'equal,' and 'less' in the gross, and we have found that they can be regarded as co-ordinate terms within a series, and that the psychophysical organism can apparently assume a constant disposition over against the

entire series without varying in attitude from term to term. By speaking thus generally we have not meant to imply that all judgments of a single category are identical, and indeed we have given warning that the term 'equal' may stand for very different judgments. Within the serial attitude there occur degrees of 'greater' and degrees of 'less,' possibly even degrees of 'equal.' We might dismiss this fact as of little importance were it not true that the various degrees of difference appear to be correlated with degrees of immediacy or delay, and delay is often described as 'hesitation,' and 'hesitation' sometimes means doubt. But doubt arises from a departure from the serial disposition, transgressing the instruction. Let us turn to the reports.

Of these degrees F has the most to say, but Bo, Bi, and E also admit their existence.

F, 11. "The judgments naturally seem to be either *greater, equal,* or *less.* It is rare that I get a *no-difference* judgment. But there is a difference among the *equal* judgments and among the *greater* and *less* judgments in the assurance or definiteness of the judgments."

F, 17. "I find considerable tendency to tell you 'how much' less very often. I think I could take a scale of 5 or 10 and say in terms of that scale how much less the sound was."

F, 18, greater: "Quite surprised. The second sound was very much greater." Greater: "Very much greater. The first was absolutely rather weak." Greater: "about 2 in a scale of 10." Greater: "Tendency to say 'not very much.'"

F, 25. "I can't see anything in the instructions to forbid me from giving these judgments on the basis of a scale of 10; so I have decided to try to get a serial set of judgments by estimating on a scale of 10. Thus, if I say 'less 10,' it means about as different as I ever get, *i. e.* the judgments are so-much *quantitatively* less. *Equal* would be 'less 0.' I don't seem to find doubtful judgments or 'or-judgments' except very rarely."

F, 26, equal: "Just a little hesitation and extra comparison. The two weren't quite identical."

F, 33, greater 8 (F is using his scale of degrees): "A quite definite organic reaction that goes with certainty and with judgments where the difference is greater than 4, say, on my scale. A different organic complex goes with hesitation, uncertainty, a not immediate judgment, such as when the difference is only 1 or 2. With the former goes the tendency to shout the judgment out; with the latter the tendency to put a question-mark in my voice and to speak slowly rather than quickly. When the judgment is 8 or 9 there is also surprise. When the judgments are around 1 or 2 I am pretty much always confused, perhaps hesitant."

F, 36. "I think you can make several distinctions of judgment: (*a*) Judgment surprisingly less, with a little shock to it. (*b*) Definite judgment, where one is automatic about giving it. There is little organic stir up; it is just normally *less.* (*c*) Judgment where there is strikingly little difference. The organics are different in these three cases. In the first case they seem to be surprise or shock. In the second they *mean* 'greater' or 'less.' In the third they are differ-

ent; there is strain in them, always strain with these smaller differences."

Bo, 44, greater. "Normal, delay. Of course there is a difference in the amount of difference between extents. I could easily make different categories of degree, say 'much greater,' 'slightly greater,' and 'barely greater,' for example; but I do not regard these categories as different in the way that is called for; they do not seem to be discrete. On the other hand, I am somewhat puzzled about them because they do seem to play a part. . . . I merely want to call attention to the fact that under the same attitude I may have very different experiences, which vary, on the side of impression, in degree of greaterness or lessness, and, on the side of subjective supplementation, in the amount of delay and the consequent patterning of consciousness, a patterning, which, in some cases, seems closely related to the attitude of doubt."

Bo, 76, equal. "Normal, but a little hesitation similar to doubt in which I wondered whether it was *equal* or *less*. Immediately after the trial I thought to myself that the difference between 'normal equal' and 'hesitant equal' is largely a difference in the appearance of the lines. When I became hesitant, I seemed to get the lines as 'less' and then as 'equal.' In other words, being doubtful in this way does not seem to be the sort of thing that doubt usually is."

Similar to F's degrees are Bo's reports of 'immediacy' and 'delay.' Bo fell into the habit of regularly reporting 'normal' judgments with phrases like the following: "Normal, immediate;" "Normal, delayed;" "Normal, slight delay;" "Normal, fairly immediate;" "Normal, perhaps a trifle hesitant." Thus immediacy and delay are always given as irrelevant to the normality of the judgment.

Bi, 70, greater: "Quite obviously *greater*, but not extremely obvious. I think *greater* was carried by a denser blackness." Greater: "Somewhat *greater*. Attention good. No definite imagery of any sort. I was pretty doubtful, because of the 'somewhat,' I guess."

E, 16, greater. "Very decidedly greater."

E, 26, less: "That seemed decidedly less. A sort of relief about it; hence easy to judge." Less: "The difference didn't seem as great. It was definitely less; still there was a different feeling about it from the last one."

E, 49, greater: "Just definitely *greater*." Greater: "No change, though the pair seemed nearer together. In both trials an attitude of assurance and satisfaction."

E gives a number of similar reports of degrees.

The evidence that there are more than three degrees within the series 'greater-equal-less' is complete. F uses a scale of 21 degrees (actually he employed but 16, however; from 'less-8' through 'equal' to 'greater-7'), but suggests that qualitatively there might be seven, three 'lesses,' an 'equal,' and three 'greaters.' The other observers are not so explicit.

The smaller degrees of 'greater' and 'less' are correlated with 'non-immediacy' or 'delay' or 'hesitation' or 'delay with alternation of judgments' or 'doubt.' It is not clear whether this state is properly to be called 'doubt' or not. It is certain that it is not the sort of doubt which we met in the *doubtful* judgments. That doubt was extra-serial and

meant a change of attitude. This takes its place within the series; its limens could be, if necessary, determined; it therefore comes within the instruction and is allowable in psychophysical method.

Bo is especially insistent upon the intra-serial nature of 'hesitation.' We quote a few of his reports:

Bo, 9, equal. "A hesitation before spoken judgment. I don't think 'hesitation' is quite the same thing as 'uncertainty,' although it is similar. 'Hesitation' is the being unable to give a judgment, whereas 'uncertainty' is the being unable to give a judgment because there is an alternation between tentative judgments."

Bo, 17, greater. "Passivity, then delay, then mechanical judgment. I think this delay isn't quite 'passivity,' because it involves searching for a way out. I am always restive under 'delay.'"

Bo, 34, equal. "Considerable delay, and something like an alternation of judgment during delay, hardly more than a strain in my chest. It was not doubt or hesitation; thus I can say my attitude was 'normal.'"

Bo, 35, equal. "I am under a tremendous logical suggestion to call any temporal hesitation or any alternation of judgments 'doubt;' but I am consciously trying to resist this suggestion because 'doubt' is an attitude and ought, therefore, in the sense in which I am using it, to feel 'doubty.'"

Bo, 41, equal. ". . . There was no 'doubt;' just hesitation and delay."

Bo, 45, equal. "That was a good normal judgment, although quite delayed." And so on.

Bi at one time equated 'slowness' of response to the 'doubt' of expectation, but later reversed his opinion:

Bi, 27. "What I call 'doubt' is slowness in accepting the judgment. It seems as if I might have had expectation and become conscious of it when the variable was given."

Bi, 38, less: "That was normal. I seemed to wait without any expectation at all. Ordinarily when I wait I seem to expect."

We may support the direct testimony of the observers as to the continuity of the successive degrees of the series 'greater-equal-less,' by an examination of F's reaction times for the various points on his judgment-scale (see next page).

Although the cases involved are very few, the curve of the times gives every evidence of being a continuous function. In fact, if it were to be regarded as discontinuous at any place, the breaks should be made between 'greater-1' and 'greater-2' and between 'less-1' and 'less-2,' for the smallest values of 'greater' and 'less' seem to group themselves more with 'equal' than with the other values of 'greater' and 'less.'

We have noted in our introductory discussion of the problem which the present experiment attacks that the most definitely recognized form of intra-serial variation is the constant

Category and its degree	Number of cases involved	Average reaction-time (seconds)
1–8	6	.74
1–7	10	.74
1–6	9	.90
1–5	5	.82
1–4	2	.68
1–3	7	1.08
1–2	3	1.00
1–1	2	2.00
=	55	1.94
g–1	2	1.90
g–2	6	1.06
g–3	7	1.06
g–4	5	.92
g–5	5	.96
g–6	10	.82
g–7	6	88

change of disposition of the organism, over against the stimulus, which is taken account of in the psychometric function. In other words, the same stimulus under the same external conditions can not be expected always to give rise to the same impression. The reports of our observers are full of accounts of this kind of change. Many examples already quoted (*e. g.* Bo, 76, immediately above) show how the impression changed while the stimulus remained constant. At another time Bo reported:

Bo, 26, equal. "Normal, although I changed from 'less' to 'equal.' The change was a change in the length of the lines; I saw the right hand line grow."

Bo, 54, less. "Normal. The right hand line got very much less while I was making the judgment."

The Normal Type of Judgment Under the Constant Attitude.—All the observers tended, in the effort to maintain a constant receptive attitude, to make passive judgments. The passive judgment, moreover, tends to become immediate, although it is not necessarily immediate. The implication is that the way to maintain a constant attitude is to dispose oneself to make passive, immediate judgments. A few quotations, in view of the many which we have already given under other heads, will suffice to show the normal type of judgment.

F, 13, less. "I am open-minded for any judgment. The judgment just comes immediately. That is all."

F, 28, greater. "First impressed me as a little greater than those of the last series. Second came as immediately greater." These

reports occur in spite of the fact that F tended naturally to be reflective and to assure himself of his judgment (and sometimes of its degree) before he reported.

Bo, 55, equal, after a 'greater.' "Normal. I haven't the least idea what made me change my judgment. The whole thing runs off like the very smoothest habit."

Bo, 74, less. "Normal. What happened was that I saw the lines, and that, after a moment, I said *less* in the same smooth automatic manner."

Bi, 23, greater. "Perfectly indifferent, mildly attentive, no expectation at all. The standard was carried in an image until the variable came. Then just a step added to it, which meant *greater*."

Bi, 29, greater. "That was an automatic judgment. No attention to standard or variable. I just found myself speaking judgment in internal speech."

R, 18, less. "The kinaesthesis which carried the meaning of the judgment was very faint. Very little that was conscious in judging."

R, 24, equal. "A little more immediate and automatic than the last. Little conscious about it."

R, 87, equal. "That judgment was almost unconscious, practically automatic. The whole mechanism of kinaesthesis has dropped out." And yet this judgment represents a change of category from *no-difference* to *equal*.

E, 5, equal. "Judgment popped out instantly; it just came."

E, 8, equal, after a *greater:* "Just simply snapped right out the minute I heard the second sound."

E, 26, greater. "That just came popping right out; perfectly definite judgment; that was all there was to it."

The prevalence of the passive, immediate judgment marks it as the type. Furthermore some of the observers (most notably Bo) adopt it intentionally as a means of meeting the requirements of the instruction. F and Bi regard it as the normal attitude.

F, 36, less. "I said *less* before I realized that the series was 'equal-or-greater.' The judgment came automatically. . . . A definite judgment is where one is automatic about giving it. That is just normally *less*."

Bo, 11, less. "I am trying to be passive and mechanical as this attitude seems the most likely to remain constant."

Bo, 22, equal. "I am trying to keep my attitude constant by judging immediately, smoothly, and automatically. I think that an indecision or change of judgment is a difference in the attitude."

Bo, 26, less: "That was normal, *i. e.* passive and automatic. I don't mean that there was a lack of attention when I say automatic, but that there was a smooth course." Less: "Normal and immediate. Immediate is the opposite of delayed. The procedure may be normal, but the meaning comes in slowly."

Bi, 37, equal. "This is my 'standard' attitude: indifferent, fully attentive."

Opposed to the immediate, passive, normal judgment is the 'reflective' judgment, which is by implication active and delayed. Most of the observers provide examples of this type, although F is the most prone to adopt it. (*Cf.* F's reaction

times, Table IV, which are much longer than those of his fellow observers.)

F, 2, greater. "The second sound was bigger, duller, thicker than the first, and something representing that bigness was in mind as soon as the second was over. After that I reviewed the experience in sensation and imagery; perhaps in kinaesthesis too, and then I felt kinaesthetically that the second was the more intense."

F, 27, greater-or-no-difference. "I wanted to say *greater-or-equal* instead. When the sound came I was immediately doubtful, as the second sound did not come either as different or not different. Then it seemed to me a little greater; then it seemed equal; then I wanted to say *greater-or-equal*. Then I thought of my instructions and it seemed to me as if *greater-or-equal* might not be in a serial series. Then it struck me that *greater-or-no-difference* satisfied the conditions pretty well, because, although the second sound did not come to me as positively 'not different,' neither did it come as positively 'different.'"

And so in many of F's reports; but they are too long to quote.

Bo, 58, equal. "I was starting to say *greater;* then hesitated and changed to *equal* because I knew *greater* was unlikely. This is not 'normal.'"

Bi, 59, equal-or-less. "I'll say *or-less* because I expected *greater*. The expectation hung on so that I judged the variable against my expected variable as if it were the standard. At least one of my two judgments was a comparison between the variable and the expected variable."

E, 16, greater. "At first it seemed as if I ought to say *greater-or-equal* or *equal-or-greater* perhaps, to get an *equal* into it in some way; but I immediately rejected that because the tendency to say *equal* was just a determination from the last experiment."

The reflective attitude is more complex than the passive; naturally, then, it gives more opportunity for variations. The doubtful attitudes, which we have found it necessary to exclude, are but forms of reflective attitudes. One dare not state dogmatically that a reflective attitude can not be maintained as constant. On the other hand, there is no evidence that it can. The safe rule in psychophysical work upon simple sensory judgments would seem to be to restrict the observer to a passive, immediate type of judgment, and to exclude all other forms by specific instruction, by the control of conditions, and, if need be, by the rejection of failures in the manner in which the failures of attention are ordinarily rejected.

The great enemy of the immediate, passive judgment is the stimulus error. The reflective judgments occur most readily when the observer is judging objective lines or objective sounds, is trying, in a sense, to be right. The impressions change, under the dispositional variations within the psychometric function, so that in a delayed judgment a single category can seldom represent the impression; hence the premium

placed upon judging stimuli rather than impressions. The immediate judgment simplifies the impression by cutting down the opportunity for temporal variation; the passive attitude creates a stable disposition. The two together tend to reduce the psychophysical correlation to its simplest terms and to render it meaningful as a scientific datum by keeping all of its conditions constant except the variant under investigation.

The Term 'Attitude.'—We may be accused of using the term 'attitude' in this paper in an indefinite sense. It is true that we did not define the term to our observers, nor have we defined it since. All the observers objected to it at first, complained that they did not know what was meant, or stated that since an attitude might be unconscious they could not be expected to report upon it. Our justification for the term lies, however, in the outcome of our work; at the end of the experiment we find the observers reporting constancy of attitude and change of attitude as a matter of course. They name and even partially describe attitudes. They still assert that attitudes are sometimes unconscious; and consequently they are still concerned lest certain attitudes, being unconscious, should be unreportable. There can be no doubt, however, that the word came to have a real meaning, and that the positive results of our present study reflect an intelligible use of the term.

We must still, however, postpone the definition of the word. Undoubtedly attitude is psychophysical. Obviously, also, it is sometimes but not always conscious. The maintenance of a constant attitude becomes at least partially feasible because there turn out to be three ways in which we can know something about attitude in general. In the first place, a new and intruding attitude may be conscious, and as such observed and reported by the observer. In the second place, a change of attitude may not be immediately conscious, but may make itself felt after the fact by some new and unusual conscious feature. For example, the observers sometimes suspected 'expectation' because they found they had given, automatically, a category which they could explain afterward only by supposing the influence of expectation. Thus we may learn of attitudes from the reported inferences of observers. Finally, the reaction-times furnish an objective clue. A wide departure from the normal reaction-time for a given variable stimulus is a strong presumption in favor of an attitudinal change, whether conscious or unconscious.

We must add that the recognition of the gross factor which we have referred to as attitude or disposition occurs in almost

any major piece of psychological work. We read in the literature of the effects of distraction, the need of avoiding distraction, the necessity of judging with maximal attention; we are told that this observer altered his criteria of judgment and that that observer used a secondary cue; we find the literature of the metric methods full of reference to expectation, habituation, and fatigue. All these discussions imply that an attempt is being made to keep the psychophysical machine constant or to take account of its inconstancy; but no one defines an attitude. And the analysis of the psychophysical disposition must wait for further investigation. Meanwhile we have demonstrated that it is possible to use the term in the gross and still to achieve results which may contribute toward the standardization of the conditions of the psychophysical experiment.

Conclusions

It is possible in psychophysical work for an observer to maintain a constant disposition or attitude over against a particular series of impressions.

Doubt and expectation and their derivatives usually violate this constant attitude. The 'doubtful judgments' of psychophysics, the 'or-judgments,' and the judgment 'no-difference,' all imply the introduction of a form of doubt which lies without the serial disposition, and must therefore be excluded from the ordinary psychophysical computations.

The judgments 'greater,' 'equal,' and 'less' may all occur under the same constant serial disposition. Various degrees of 'greater' and 'less' may also be given under the constant attitude.

The immediate and passive type of judgment is favorable to the maintenance of constancy of attitude. A reflective judgment, on the contrary, favors dispositional change.

If, then, our results are confirmed by other investigators, it will be advisable in future psychophysical work so to frame instructions and so to direct preliminary practice that constancy of attitude and immediacy of judgment become natural and normal to the observers. The end cannot be attained by prohibition of the 'doubtful' judgment or by the requirement that the observers guess at a difference in every case; for these instructions secure constancy of the expression of judgment at the cost of instability of attitude. The observers must rather be trained in such a way that the experimental situation, while it may prompt to the response 'delayed equal,' *e. g.*, shall not suggest the response 'doubtful.' If with some observers or under certain circumstances the *doubtful* judgments persist, they must be made the subject of special study on their own account, and not included in the data used for the regular computation.

THE SIGNIFICANCE OF STIMULATION IN THE DEVELOPMENT OF THE NERVOUS SYSTEM

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The unit in the nervous system is the neurone. It is now pretty generally accepted that this unit—made up of the cell body and its processes, the protoplasmic processes, or dendrites, that convey nervous impulses to the cell body, and the nerve fiber, axon or neurite, that conducts nervous impulses from the cell body,—is an anatomical unit, a functional unit, a trophic unit, and a genetic unit. The nervous tissue is made up of millions of such neurones. But all are functionally connected and integrated into a system. The child has as many neurones as the adult, but they are undeveloped.

It has long been known that stimulation is a condition of development in the nerve centers. The classic investigations by Held and others have shown, too, that stimulation hastens development. More recent studies have shown not only that the development of the nervous system in the individual and in the philogenetic series has been conditioned by stimulation from the external world, but also that function and stimulation have been fundamentally significant in the development of the individual neurones. It is the purpose of the present paper to trace briefly some phases in the development of the nervous system as determined by stimulation.

Our knowledge of the genesis of nervous tissue is still inadequate. It seems, however, most in harmony with the knowledge we have, to suppose that it developed *pari passu* with the growing complexity of reactions to the stimuli of the environment. Thus with the reactions similar to the tropisms and the like in primitive animals there developed a mechanism for coördinating such reactions. In general this development has taken place in connection with the function of reacting to stimulation. In certain lower orders of animals, the corals, for example, nerve cells and fibres are evenly distributed to the whole surface of the body. In other animals, those parts most favorably located for receiving impressions from external objects become more richly supplied with nerve cells (29).

In the medusa this location is the rim of the bell. In the echinoderms it is around the mouth, and here is developed a

ring of nerves. The bell rim of the medusa, and the oral ring of the echinoderms with its radiating paths, represent a central nervous system with which the rest of the nerves may be contrasted as peripheral. Thus the nervous substance originates in contact with the stimuli of the external world.

Again, in the embryo the nervous substance is formed, not from the mesoblast, but from the outer germ layer, the ectoderm or epiblast, in response, as it were, to external stimuli, and then folded in to form the nerve tube, the original form of the central nervous system.

Thus both in the individual and in the phylogenetic series the nervous system seems to have been developed under the stimulus of the external world. As the nervous system becomes more and more complex we find certain special structures or special organs developed in connection with the reaction to certain stimuli; and finally, we have the marvelous mechanism of the human brain and its connections with the external world.

From the functional point of view Herrick (12, p. 36) has summarized the evolution of the nervous mechanism as follows:

> "The functions which characterize the nervous system have been derived from those of ordinary protoplasm by further development of three of the fundamental protoplasmic properties, viz., sensitivity, conductivity, and correlation. The most primitive form of nervous system known is diffuse and local in its action, but in all the more highly developed forms the chief nervous organs tend to be centralized for ease of general correlation and control. Most of the types of nervous systems found in the animal kingdom are represented in two distinct and divergent lines of evolution, one adapted especially well for the reflex and instinctive mode of life and found in the worms, insects, and their allies, and the other found in the vertebrates and culminating in the human brain with its remarkable capacity for individually acquired and conscious functions."

The great function of the nervous system from the physiological point of view is the coördination and integration of movement and the adaptation of reaction to sensory-motor experience. This has been shown in detail by Sherrington and others (23a).

As has often been pointed out, the nervous system is a mechanism for converting stimuli into reactions. It has been customary to look upon the reflex arc as the type of all that is accomplished by the nervous mechanism. The essential parts of the process are three: first, an incoming nervous current along an afferent or sensory nerve; second, a central process more or less complicated; third, an outgoing nervous current along an efferent or motor nerve to innervate a muscle

or a gland. All the accomplishments of the nervous system have usually been described as reflexes or combinations of reflexes.

To take a concrete case, the classic illustration is as follows: If one puts a drop of acid on the thigh of a decapitated frog, immediately the leg is drawn up in the attempt to brush off the irritating substance. Here we have an example of the simple reflex arc. The course of the nervous impulse is briefly as follows: The nervous impulse caused by the stimulation of the nerves of touch in the frog's thigh is carried by the afferent sensory nerves to the sensory cells in the dorsal part of the cord, then the impulse is transferred by the central nervous processes to the motor ganglion cells in the ventral part of the cord, and the excitation of them causes an outgoing nervous current along the efferent or motor nerve which innervates the muscles of the frog's leg.

The essential elements of the anatomical structure involved in a reflex are three: first, a receptor or sensory receiving organ; second, a connector, or adjustor, the nervous tissue connecting the afferent nerve with the efferent or motor nerve; and third, the effector, consisting of the mechanism of response. Or we may divide the mechanism more concretely as Herrick (12, p. 25) does, into five parts as follows:

"(1) A sensitive receiving organ (receptor or sense organ); (2) a conductor (afferent or sensory nerve) transmitting the nervous impulse inward from the receptor; (3) a correlation center or adjustor, generally located within the central nervous system; (4) a second conductor (efferent or motor nerve) transmitting the nervous impulse outward from the center to (5) the effector apparatus, consisting of the organs of response (muscles, glands) and the terminals of the efferent nerves upon them."

The sequence in the development of this mechanism is not altogether clear. The studies of sponges and other lower forms of animal life by Parker and others, however, indicate that the muscle preceded the nerve in its evolution and was the first element of the reflex arc to be developed. Sponges, for example, represent animals with effectors without differentiated receptors. Evidence is furnished also by certain reactions in the higher animals. To quote Parker (22, p. 124):

"If muscle originated before nerve and was brought into action at first by direct stimulation, it is natural to expect that examples of this form of response might still be found among the higher animals. And such seems to be the case. Thus the sphincter of the iris in the lower vertebrates, though well known to be under the influence of nerves, was shown by Steinach some time ago to be directly stimulated by light, a condition which. judging from the more recent work of Hertel, probably applies even to the human eye. This muscle then exhibits a certain

capacity for normal direct stimulation. Another example of the same kind is seen in the embryonic vertebrate heart. Though the beat of the adult heart may be a matter of controversy from the standpoint of the myogenic and neurogenic theories, there can be no doubt that the muscle of the embryonic heart beats, as shown by His, before it has become invaded by nerves. And this view is supported by Barrow's recent discovery that the isolated cells of the heart-muscle will contract rhythmically under conditions where not the least vestige of a nerve can influence them. Thus the embryonic heart-muscle and the sphincter of the iris are muscles whose activity may be normally called forth by direct stimulation, a condition which reproduces, so far as independence is concerned, the state met with in the muscles of the sponges. These examples then show that even in the higher animals certain muscles respond normally to direct stimulation and thus exhibit a form of activity which is believed to be generally characteristic of sponges."

A good example of a very primitive form of nervous system is that found in the sea-anemones. As described by Parker (*22*, p. 121), these are sac-like animals with a single opening leading into the digestive cavity. The animal has no well-defined organs except the digestive apparatus and is merely a membranous digestive sac. The body of the sea-anemone, however, contains both nerve and muscle, occurring over almost the whole of the animal. Each part seems to carry its own neuro-muscular mechanism. The nervous system in the sea-anemone is diffused rather than centralized. No part of the animal's nervous organisms seems to be more important than any other part; it consists of a vast number of sensory neurones which connect the surface of the animal with the underlying muscles. Its function is merely the reception of stimuli and the immediate excitation of the muscles. The nervous mechanism is a receptor that acts as a trigger for setting off the muscle. That is, the animal consists merely of receptors and effectors without the intervention of an adjustor or a central organ.

Afterward as these receptors became more highly developed, the third element, the central nervous element, was evolved. This serves as an adjustor, a means of connection and correlation between the receptor and the effector. Thus the order of development was: first, the effector; second, the receptor; and third, the adjustor or central organ.

Thus the nervous system originated "at spots," probably where the animal had developed muscle, and was later unified. As Parker has expressed it (*22*, p. 127):

"Although the nervous system probably arose in a scattered way at spots where the primitive multicellular animal had developed muscle, it became unified through the need for general transmission tracts, and, by increasing its own elements as well as by appropriating additional

effectors and receptors, it has impressed upon the higher animals, including ourselves, a unity so profound that it includes everything that we mean by personality."

Another class of recent investigations show that there are kinds of nervous action not adequately described as reflexes at all. Hough, in a recent paper, distinguishes the following classes of nervous action: automatic, axon reflex, unconditioned reflex, conditioned reflex and volitional. For the present purpose it will be sufficient to note the automatic, unconditioned reflex, and conditioned reflex action of the nervous substance, and here we may well follow Professors Hough and Brown (14, p. 410):

"In the central nervous system the best known and most successfully studied case of automatism is that of the respiratory center. The conclusion which Rosenthal drew from his experiments, that the nerve cells of this center send out rhythmic discharges when removed from all connection with afferent nerves, has been confirmed by all subsequent work, the experiments of Winterstein being especially conclusive on this point."

"The work of T. Graham Brown suggests that the same thing is true of the rhythmic movements of locomotion. Brown shows that in a certain stage of ether narcosis in the decerebrate animal, when reflexes can no longer be elicited from the afferent nerves, rhythmic movements of flexion and extension occur in the hind legs; and furthermore, that these movements occur after the afferent nerves from the moving limbs are cut. In other words, these movements which suggest the basis of the movements of locomotion, involving as they do the alternate rhythmic action of antagonistic groups of muscles, are executed by efferent neurones without any stimulation from afferent neurones. They constitute 'an endless chain,' but not an endless chain of reflexes."

Brown (14, p. 411) raises the question whether these automatic actions of locomotion do not present a more primitive form of nervous activity than the reflex. He suggests that "the nervous mechanism of locomotion, like the nervous mechanism of respiration, is fundamentally an automatic mechanism. Later on afferent neurones are added to it, comparable to those of the pulmonary branches of the vagus. In this connection it is most significant that in general the same conditions so frequently referred to as stimuli of the respiratory center—.ack of oxygen, excess of carbon dioxide, etc.—are the very conditions found to favor the movements of narcosis progression."

Apparently in such automatic nervous action we have nervous action without stimulation. The exception is, however, strictly more apparent than real. It would, perhaps, be better to say that in case of automatic nervous action the stimulus is within the central nervous organ itself instead of being carried to it by a receptor organ. Especially if we take

Verworn's definition of a stimulus (27), as any change, we are justified in taking this view. The automatic nervous action is like all other nervous action, response to stimulation, but in this case the stimulus is internal.

As the highest form of nerve action we have the association of stimuli in the production of conditioned reflexes. As shown by the Russian school of Pavlov, in the higher animals the stimulus from any receptor organ may become associated with the natural or biologically adequate stimulus that produces a given reaction and produce the same reaction. This is called a conditioned reflex in contrast with the ordinary or unconditioned reflex. The difference between the one and the other may be very simply illustrated.

If you give your dog a piece of meat a secretion of saliva occurs. This is an ordinary reflex. If every time you feed your dog meat you ring a bell, after a little while you can ring the bell without giving the meat and there will be a flow of saliva. The ringing of the bell has become associated with the stimulus of the meat and produces the same reaction. Such an associated stimulus is called a conditioned stimulus, and the reaction produced, a conditioned reflex. This is a most remarkable phenomenon. An entirely indifferent stimulus associated with the ordinary stimulus produces the same physical effect. This association is effected by the brain cortex.

Thus, as the genetic sequence for the elements of the reflex arc is: first, the effector; second, the receptor; and third, the adjustor; so in its simplest form the genetic sequence of the different forms of nervous action is probably as follows: automatic action, reflex action, conditioned reflex action.

A helpful distinction for the genetic point of view is that between the paleencephalon, or old brain, and the neëncephalon, or new brain, sometimes called the pallium or brain mantle. As Edinger (5, p. 12) expresses it: "The most important thing of general significance which comparative anatomy teaches is this, namely, that the whole mechanism of the spinal cord up to the olfactive nerve is in case of all the higher and lower vertebrates similarly organized; that therefore for the simplest functions through the whole series a similar basis exists whether it is a question of man or fish. This fundamental part of the brain, the old part, we may call the paleencephalon." In contrast with this is the more recently developed part of the brain, the neëncephalon, or the brain cortex and its dependencies.

Neëncephalon in black
Paleëncephalon in gray
(After Edinger)

The former, the paleëncephalon, was the original brain. It consists of the cerebellum and the brain stem; and the neëncephalon consists of the part of the brain superimposed on these basal portions, the cortex and its dependencies. Hence the name brain mantle.

The paleëncephalon mediates movements, the reflexes, and many instincts. Locomotion, posture, the processes of nutrition and other vital processes are controlled by it. The neëncephalon, on the other hand, mediates the functions of association and the higher mental processes.

Not only the old brain but also the new brain has developed in behoof of adjustment to the environment. In Edinger's words (6):

"Wherever we investigate, everywhere the development of separate parts of the paleëncephalon appear dependent altogether on the manner of life. Traces of the neëncephalon, an apparatus which folds itself over the paleëncephalon, appear in the case of selachians, and become greater in case of the amphibians. In a continuous series it increases through the amphibians up to the mammals, and in the latter it develops to the enormous structure which in case of man becomes the bearer of all the higher mental functions. If we divide all actions into those of the paleëncephalon and those of the neëncephalon according as they are performed by one or the other of the two great divisions of the brain, we acquire a principle of classification and study for comparative psychology."

While no hard and fast divisions occur in neurological development, any more than dramatic epochs are found in psychological evolution, we do find with the appearance of the neëncephalon a new form of behavior, and new possibilities for the development of intelligence. Fishes have only the paleëncephalon. The rudiments of the neëncephalon are found in selachians and amphibians. The neëncephalon appears definitely in reptiles. And as Edinger (6, pp. 453-4) says:

"Finally, in the mammals we meet a brain which has so large a neëncephalon that we may well expect a subordination of reflexes and instincts to associative and intelligent actions. That, in fact, is the case with those mammals in which the neëncephalon includes much more than half the bulk of the entire brain. But in many families there is very little advance beyond the condition prevailing in birds, for example, in the hedgehogs and the moles. In the mice, the rabbits, in fact in nearly all the rodents, the two parts are about evenly balanced. What we know of the intelligence of these animals—and that is little enough—is in very close accord with the condition of the brain."

Again, as Edinger (6, p. 447) has pointed out, a distinct advance appears with the advent of the neëncephalon. This change of behavior is especially noteworthy in the activities related to the taking of food.

"Hungry animals," he notes, "if they possess only the paleëncephalon seize food under all circumstances, provided the stimuli which proceed from it are appropriate, but only then. An animal which is incited to seizing only by a moving body never recognizes the same body if it is at rest. All of these animals can be caught with bait if one has ascertained the proper stimulus. Fishes which, like the trout, go toward

swiftly moving and glittering insects can be caught by imitations of such insects constructed of metal and feathers, providing the angler rightly imitates the hopping movement. The entire art of angling, concerning which we possess large volumes, depends upon knowledge of the proper stimulus and upon the excluding of disturbing stimuli, such for example as a thick fish-line. Frogs may be caught by means of heath-berries dangled before them on a string. Even the frog has a rudimentary neëncephalon, but so far as my observations go, it plays no part in the obtaining of food. It still eats paleëncephalically. No matter how hungry a frog may be, it seizes the earthworm only when it crawls, or catches the fly only when it makes some movement. One may lay a worm on the frog's snout or may in any way bring the two in contact, but eating does not result. The worm acts as a stimulus only when crawling, otherwise it is not recognized."

Thus while the paleëncephalic animal is stimulated by its prey only when the latter moves, serpents, on the other hand, once stimulated by a jumping frog or a running mouse follow their prey, at least for a time, and are able, perhaps by the olfactory sense, to find a particular hole into which the prey has crept. Lizards and serpents also assume an attitude of defense when danger threatens. They direct the head toward the enemy and attempt to bite. Edinger says he has never observed anything of this kind in a paleencephalic animal. Among reptiles also for the first time one meets with individual differences; in the same species there are indolent and excitable individuals; this, too, is probably due to the neëncephalon. And finally, reptiles learn more easily than fishes. Again to quote Edinger (6, p. 450):

"Most important in the psychological behavior of reptiles is the fact that the animals are no longer always dependent upon the sense impression of the moment, but that earlier impressions influence them. Further, they associate certain sense impressions which lie within the realm of the olfactory and oral senses, and turn them to account; they learn more easily than fishes and amphibians; occasionally they foresee; and they exhibit individual differences. There can be no doubt that all of these facts are referable to the appearance of a cortex in the neëncephalon."

Edinger sums up his view of the relations between the structure of the nervous system and its activity in substance as follows (5, p. 221): The paleëncephalon functions impressions and motions, often of a very complicated sort. Above these is developed in continually increasing degree with the growth of the cortex the ability for knowing and doing. This has its basis in the sense centers of the cortex, an apparatus to which we must ascribe the ability of coördinating the impressions that come from the paleencephalon with numerous others in such a way that it can inhibit and again reproduce them if similar or related impressions stimulate it. Thus knowing leads to doing.

Separate parts of the cortex are more directly connected with the peripheral sensory apparatus, others more with the peripheral motor apparatus. With these parts of the brain are associated other areas of the cortex, especially in the frontal lobe; and with the appearance of this, the intelligence first appears clearly, along with knowing and doing.

The reactions brought about by the paleëncephalon in response to stimuli, the actions which proceed from the sense centers on occasion of perceptions, are similar in case of man and animals. Indeed, the animal is sometimes far superior to man in both of these. Only one thing is developed in case of man far more than in case of animals, namely, the association centers, especially the frontal lobe; and with this, high intelligence, which presupposes consciousness; but since the frontal lobe is present in different degree even in animals, we are forced to the assumption that many actions of animals must be accompanied by the functioning of this part of the brain. "Comparative anatomy," says Edinger, "becomes here the pathfinder of psychology."

An important point not always noted is the increased scope and importance of cortical control in the higher animals, especially in human beings. The child reported by Edinger (7), born without a neëncephalon, was incapable of the simple functions that a dog deprived of its brain can perform. And apparently many movements that are completely and perfectly executed by the paleëncephalic animal are brought under control of the cortex in the higher animals and man. Thus with greater and greater development in the animal series there is more and more centralization in the neëncephalon. The physical basis for this is apparently the new groups of neurones leading to the cerebrum that are added with greater development. Pike (23, pp. 392, 395) illustrates this as follows:

"It has been shown anatomically and experimentally to some degree, that new groups of nerve cells and fiber tracts appear in the central nervous system as we pass from the lower to the higher vertebrate forms. These new tracts and cell groups lead more and more to the cerebrum or become located in it; hence, the greatest development of the cerebrum and its afferent, efferent and association paths occurs in the human nervous system. As a rather familiar example, the pyramidal tract, arising from cells in the cerebral cortex of the higher vertebrates, may be cited as one of the phylogenetically newer tracts. The frog has no pyramidal tract, but depends upon the rubro-spinal tract as the important part of his motor mechanism.

"In any motor response a great number of afferent impulses of various kinds are involved. It is apparent also that some of these impulses go to the cerebrum almost directly. There is much evidence to show

also that in the higher animals, nearly all other impulses, including those to the cerebellum, get to the cerebrum before they become effective in influencing the motor response."

"Attention shifts therefore, from the afferent pathway to the central system. Somewhere these afferent impulses must be gathered up . . . and passed on to the motor cells directly. The very complexity of the process is sufficient evidence that no one restricted group of cells constituting a hypothetical center could accomplish all of the things to be done. At the present time there is good, and even sufficient, reason for believing that nearly all of these impulses, including those from the cerebellum, pass through the frontal lobes of the cerebrum on their way to the motor neurones. On this view the cerebrum is an essential part of the great motor mechanism. It is in the cerebrum that the summing up or integrating of all the afferent impulses occurs."

Recalling again the reacting function of the nervous system we may note that, among recent writers, Dr. Dearborn (3) maintains that the conception of the reflex arc and of the combination of reflexes give but an inadequate idea of the great complexity of the processes involved, and he thinks that the facts, as we now know them, are better represented by the figure of a circuit and a hierarchy of circuits in which the lower are more or less under the control of the higher. But the facts are even more complex than this.

It is of fundamental importance for the understanding of the genetic point of view, both in neurology and in psychology, to keep in mind the fundamental metabolic and functional processes of the neurones. Not only are the nerve centers and the nervous system as a whole functionally active, their health as well as their efficiency depending upon their functional activity, but even the development of the individual neurone is determined by its metabolism and its functional ability in responding to stimulation. It is well to note briefly here some of the main points in the rather technical contributions made in recent years by the Dutch neurologist Kappers, the Spanish neurologist Cajal, and others.

In 1907 Kappers (1, p. 557) proposed the theory of neurobiotaxis, and in the following year formulated the following laws: 1. If discharge of stimuli occurs in different parts of the nervous substance, then the development of the chief dendrites, and especially the location of the whole body of the ganglion cell, occurs in the direction of the maximal discharge of stimuli.

2. This approximation of dendrites or of cells takes place only between places stimulated simultaneously or in direct succession.

3. The development of the axis cylinder of the so-called central motor system is not conditioned primarily by the motor

function of certain cells, but likewise by the areas stimulated synchronously or successively.

To summarize the law: dendrites and neurites grow in the direction of areas that are stimulated simultaneously with them. This law is in harmony, Kappers maintains, with the psychological law of the association of simultaneous stimuli. Thus he maintains that the fundamental law of psychology is a fundamental law of brain anatomy (1, p. 557).

Kappers has given many illustrations of this law from his studies of phylogeny, illustrations not only for the dendrites, but also for the neurites, and illustrations also of the adjustments or displacement of the cells in connection with this development. Bok (1) in his recent studies has furnished illustrations from the development of the individual. Thus we have now evidence both from phylogeny and ontogeny, which show at least that the processes of the neurones develop especially in the directions of the greatest discharge of stimuli.

Bok has studied the development of the processes in the neurones of chicken embryos, and finds that stimulation is the determining cause of the development of the fibrillae and of the nerve paths. As the result of his studies he has made important corrections to Kappers' law and formulated three general rules in regard to the development of new paths (1, p. 537-539).

1. New paths develop from neuroblasts located near paths that already exist.

2. The young neurone in the beginning has no contact with the path that stimulates it. This is a result of the known fact that the neurite develops sooner than the dendrite. The contact mentioned does not arise until later, by two processes —by the outgrowth of dendrites of the neuroblast and by the formation of collaterals through the path. The activation therefore is in a certain sense a distance-effect, although the distance that is here bridged is a rather small one.

3. The new fibrillae develop in the direction of this stream of stimulation radiating from the path that already exists.

"This coincidence," Bok (1, p. 542) argues, "of the direction of the young fibres, which can be established everywhere, and that of the stimuli coming to them cannot rest on chance, but forces us to consider this stream of stimulation as the cause of the development of the nerve fibres in its direction. The protoplasm located there adapts itself to its function, namely, the conduction of stimuli, by the development of nerve fibrillae. Accordingly this formation of nerve fibrillae and of paths can be referred back to a generally recognized fundamental principle in biology, the adaptation of the protoplasm to repeated function."

also that in the higher animals, nearly all other impulses, including those to the cerebellum, get to the cerebrum before they become effective in influencing the motor response."

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Bok formulates his hypothesis of the development of the fibrillae in accordance with this law, as follows (1, p. 542): "Constantly repeated stimuli cause fibrillae to develop along their course."

Every neurite, however, grows with the stream of stimulation, hence away from the cell body, but the dendrite grows in the opposite direction, that is, toward the stream of stimulation. The dendrite is rich in protoplasm, the neurite almost totally free from protoplasm; and we come to the conclusion that protoplasm has the tendency to displace itself in the direction of the stimuli, that is, to seek out the source of stimulation.

Kappers (1, p. 557) showed similarly that the growth of dendrites is determined in the direction of the maximal discharge of stimuli. Thus the ganglion cells in a certain degree are to be compared to the amoeba. The latter sends out its pseudopobia toward the place where the most nourishment is to be found; the nerve cells allow their dendrites to grow in the direction of their functional nutrition, that is, in the direction of their stimulation, and here we can speak of a stimulotaxis just as we do of the chemotaxis in the case of an amoeba.

This displacement of the protoplasm in the direction from which the stimuli come is not always limited to a part of the cell, but can also occur in the whole cell body so that this migrates in the direction of the stream of stimulation in a manner analogous to the movement of the amoeba in the direction of its nutrition. The displacement of the cell therefore occurs in the direction from which the stimuli come, and it is easy to see that thus it occurs in the direction of areas that are simultaneously stimulated, that is, in the direction of the source of the stimuli which stimulate the cells.

Kappers points out that cell-migration in a certain direction is generally preceded by an outgrowth of a large dendrite in which the shifting of the cell takes place. The theory that the dendritic outgrowth follows a preformed plasmodermic path cannot, he maintains, explain the shifting of the cell. His studies, on the other hand, "now covering all the cranial motor nuclei in all classes of vertebrates, have taught him with certainty that for this phenomenon only the process of taxis or tropism exercised by the centres from which the majority of stimuli proceeds to the cell and its dendrites can be considered as responsible." The dendrites therefore demonstrate the law of neurobiotaxis in the manner of their growth.

Kappers (17) in more recent studies has found that the den-

drites are apt to take a shape which gives a maximal amount of surface as a means for enlarging the area for the receptor elements, and he concludes that this surface extension of dendrites of certain cells indicates that here, too, we have to do with a process of neurobiotaxis, a striving for the maximal reception of stimulation in the shortest manner.

Bok (1, p. 561) summarizes his results in substance as follows: If we think of the partially developed nervous system as functioning, the stimuli accumulated in certain paths will radiate from the naked axis fibres into the surrounding protoplasm.

New paths always develop where a diffusion of stimulation of this kind takes place. The young fibrillae develop therefore in the direction of the stimuli, in protoplasm lines which have been marked out by repeated stimulation. They develop hence, from the neuroblast which has been traversed first and is therefore most strongly marked out by paths. This is the basis on which the hypothesis of the generation of fibrillae by stimulation rests.

Repeated streams of stimulation cause fibrillae to develop in their direction. The formation of fibrillae, according to this hypothesis, is in harmony with the general property of protoplasm to adapt itself to a repeated function.

This assumption is supported by the observation that a path at the moment another path appears activates new neuroblast substance along its whole length, from which the neurites again develop in the direction of the stimuli.

Since protoplasm has the tendency to approximate its source of stimulation (positive stimulotaxis), we see that the dendrites are rich in protoplasm, the neurites poor in protoplasm, and that the whole cell body tends to take a position in the direction of the stream of stimuli conducted toward it, that is, according to the law of neurobiotaxis.

This consideration of the history of the development of the system of paths teaches us that the paths do not in the first instance prescribe the way for stimuli, but that it is precisely the stimuli which bring about the configuration of the paths. With the constant action and reaction between structure and function in the central nervous system, function is the primary cause of the arrangement of the anatomical substrate; and thus Bok (1, p. 562) quotes the words of Schiller and says that this gives a deeper meaning to the words of the great German poet: "*Es ist der Geist der sich den Körper bildet*"; "It is the mind which forms the body."

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While admitting our ignorance in regard to the poetic interpretation in the closing sentence of Bok's summary, and without attempting to solve that problem of the priority of structure or function, we should note the emphasis upon the influence of function on development brought out by his results.

One is likely at first to fail to recognize the significance of these contributions. If these laws formulated by Kappers and Bok be true, then we have a contribution here of fundamental importance for genetic psychology. Long ago Zanotti and Hume pointed out the fundamental character of the law of association in psychology, comparing it to the law of gravitation in the physical world. Here in the doctrine of the genesis of neural processes and paths we have at least the adumbration of a law equally fundamental for neurology and genetic psychology.

The results of these investigations indicate the neural basis of what Hering (11) long ago called "memory as a universal function of organized matter." This appears as a general property of protoplasm itself, the ability to adapt itself to the functions it performs.

In some such way as the amoeba reacts towards its food, sending out pseudopodia in the direction from which the most nutriment comes, so the protoplasm of the neurone reacts toward the stimuli which affect it, the dendrites growing especially in the direction of the source of stimulation. It is noteworthy that they are the protoplasmic processes of the neurone, and that on the other hand, the neurite or axon, which grows with or in the direction of the stream of stimuli conducted from the cell body, is relatively free from protoplasm.

Just as the reaction of the protoplasm of the amoeba toward its food is called chemotaxis, so the reaction of the protoplasm of the neurone toward the source of stimulation may be called, as suggested by Bok, positive stimulotaxis.

If we add the further evidence of the modification of the neurone by stimulation, from the fact that the cell body itself is sometimes displaced in the direction of the stream of stimulation; that the dendrites show a tendency to spread out in an extended surface in order to give a maximum area for the reception of stimuli; and the fact that the cell body grows with its functional activity, and suffers arrest or atrophies when stimulation ceases; and if we bring into connection with these facts in regard to the development of the neurone the well-known facts in regard to facilitation (2), or what the

Germans call Bahnung, a second application of a given stimulus at a suitable interval having a greater effect than the first, we have an indication of the neural basis of memory and association.

Conclusion

The studies by Parker and Brown suggest the probable genesis of nervous action. Further investigations will probably harmonize these results and give more definite knowledge in regard to the early stages and sequence of development of nervous structure and function. As regards the main point the evidence all points in one direction. If we study the philogenetic series, we find that even before the nervous system appears, reaction to the environment is the significant fact, and that probably the nervous system develops at spots where the primitive animal developed muscle. If we study the individual we find that in the embryo the nervous substance is developed from the outside layer, the epiblast, where the organism comes in contact with the external world. And if we study the individual neurone we find that its development is determined largely by its functional ability to respond to stimulation, its dendrites especially developing in the direction from which the most stimuli are received.

The significant thing is that all of these studies show what has been emphasized over and over again, namely, the significance of function and the fundamentally dynamic character of every neurone. We find here what we find everywhere as we study the physiology and hygiene of the human organism, that function, action, expenditure of energy, as well as the storing up of energy, are the fundamental conditions of life and health. Function is the Alpha and Omega of individual life as well as of the universe in general, a profound illustration of the words of Goethe, "*In der Anfang war der Tat.*"

While the nervous system is, as the older writers already knew, a mechanism for converting stimuli into reactions, our genetic point of view has shown further the two great divisions of stimuli: On the one hand, those that are biologically adequate; on the other, those that act only by association. The former bring about ordinary reflexes and instinctive activities; the latter bring about conditioned reflexes, habits, and the like. The former are mediated by the paleencephalon, the latter by the neëncephalon.

The ability of neurones stimulated simultaneously to affect each other and the ability of the brain cortex to associate

stimuli carried to it simultaneously by different receptor organs, form the neurological basis for mental association, at once the fundamental law of psychology and the foundation for the whole of mental hygiene.

Thus without going into details we can trace the genetic course of development of the nervous system as a reacting mechanism.

1. The nervous system originated in contact with the external world.

2. It originated in spots where the primitive animal had developed muscle.

3. The sequence of the genesis of the reflex arc was: first, the effector organ; second, the receptor organ; third, an adjusting mechanism connecting and correlating the other elements of the reflex arc.

4. There are different forms of nervous action, especially automatic nervous action, reflex action, and conditioned reflex action.

5. The sequence of development seems to have been: first, automatic nervous action; second, reflex action; third, conditioned reflex action.

6. The central nervous system may be conveniently divided into the paleëncephalon and the neëncephalon. The paleëncephalon mediating reflexes and instinctive actions, and the neëncephalon mediating especially association and knowledge.

7. With the higher stages of development there is more and more of centralization in the neëncephalon and more and more of cortical control.

8. The individual neurones develop their processes in the direction of the greatest discharge of stimuli, the dendrites toward the stream of stimuli, the neurites with the stream of stimuli.

9. We find the neurological basis of association in the working out of paths in the nervous substance between areas simultaneously stimulated.

10. Two kinds of stimuli may be advantageously distinguished: first, those that are biologically adequate, or what may be called unconditioned stimuli; second, those that are associated or may be called conditioned stimuli.

Thus we see from the genesis of the nervous system that the one condition necessary for normal development is a rich environment giving plenty of stimulation and freedom for the nervous mechanism to develop in its own way. This seems especially important for the higher parts of the nervous system, the new brain, or the cerebral cortex and its depend-

ent structures. The same thing is emphasized, too, by all those cases of defect where normal stimuli are shut off. In such cases there is always imperfect or arrested development.

The wider relations and wider significance of stimulation and response are suggested by our survey of the development of the nervous system. When we see the rôle of stimulation in the genesis of the nervous system, it need not seem strange that stimulation conditions the normal activity of the organism; conversely, when we see how stimulation is the condition of normal physiological activity, as illustrated so admirably in the physiology of respiration as described by Haldane, it need not surprise us that stimulation conditions the development of the nervous system. No static conception of the human body or of any individual organ is in harmony with modern science or modern philosophy.

Thus the genesis and development of the nervous system gives us the point of view and the method for the study of the hygiene of the brain and mind. This is distinctly in harmony with the point of view and method of the newer dynamic physiology and the newer functional psychology.

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AN ANALYSIS OF A PHASE OF THE PROCESS OF CLASSIFYING[1]

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I. Introduction

In the course of a recent study of the process of generalizing abstraction,[2] we discovered that our conditions offered exceptional opportunity for an additional investigation of the

[1] From the Psychological Laboratory of Clark University.

[2] The Process of Generalizing Abstraction; and its Product, the General Concept. *Psychol. Mon.*, 1916, No. 90.

process of classifying. Accordingly, we introduced experiments which were directed to the analysis of this process in one of its phases; and the object of the present paper is to set forth the results of these experiments.[3]

II. Description of the Experiment

A. Problem. Our specific problem was to investigate the mental contents which are involved in the process of classifying, or refusing to classify, novel percepts with a group already familiar. Our approach to the problem has been a genetic one; our aim was to arrange conditions so that the extent of the observer's experience with the group, and hence the possibility of rapid and accurate classification of novel percepts, should increase as the experiments progressed.

B. Method. 1. *Materials and Apparatus.* The material of our experiments consisted in a series of drawings which were analogous to other drawings employed in the experiments on generalizing, and constituting the raw-material of the general concepts formed by the observers in those experiments.

In the experiments on generalizing, we employed four groups of ten drawings each, the drawings of every group containing certain characteristics which were common to the group, and others which were not common. These drawings were of unusual shapes, and they represented no particular objects. With each was exposed a meaningless word which represented the class name of the group, the four words being 'Zalof,' 'Deral,' 'Tefoq,' and 'Kareg.' A group of ten drawings (*e. g.*, the Zalof group) was exposed successively to the observer, who was told that he would subsequently be asked to define the group name (*e. g.*, give a definition of 'Zalof'). The successful performance of this task necessitated the observers' looking for the features which were essential to the group. The presentation of the series was repeated at weekly or semi-weekly intervals until the observers ceased to note novel characteristics in the features, when the presentation of another series was commenced. A complete account of the material and method will be found on pp. 34 ff. of our monograph.

The drawings which we employed in our present experiments were capable of arousing novel percepts of a sort comparable with the other homogenous percept groups already experienced by the observer. Of these drawings, some con-

[3] The importance of the investigation of the classification-consciousness has been pointed out by Royce (Recent Logical Inquiries and their Psychological Bearings, *Psychol. Rev.*, 1902, 9, 105-133.) We have found little or no experimental literature bearing directly on the subject of the conscious nature of classifying; this subject has been treated in the literature in close conjunction with the subjects of generalization and the concept. A résumé of the literature of generalization will be found in our monograph on generalizing abstraction (*op. cit.*)

tained the features which were essential to some one of the four generalization-groups, and consquently were homogeneous with this group. Others of these drawings lacked one or more of the essential features, while still others were totally novel. Table I presents (in the first column) the number, (in the second column) the correct classification, and (in the third column) a description of each drawing.

The drawings were made on sheets of four-ply white cardboard similar to those employed for the generalization-drawings. The size, as before, was 20.5 by 12.5 cm. The drawings of the classification-series were exposed singly to the observer (for classification) on a simple tachistoscope, the exposure being made by means of raising or lowering a thin wooden shutter.

2. *Observers.* The observers were five in number. All were trained and skilful introspectors. All excepting one were members of the department of experimental psychology of the University. They were Dr. J. W. Baird, Dr. S. W. Fernberger, Dr. E. O. Finkenbinder, Dr. Miriam van Waters, and Dr. Elizabeth L. Woods.

3. *Procedure.* The experiments were conducted in close conjunction with those on generalizing. After the observer had seen and defined a generalization-group (*e. g.*, Zalof), he was shown a member of the corresponding classification-series, his task being to state whether or not the drawing was to be classified with that series (*e. g.*, "Is this a Zalof?"). He was subsequently asked to furnish an introspective account of his experience in classifying or refusing to classify the stimulus with the group. The time required for making the classification-judgment was taken by counting the ticks of a stop-watch between the time of the raising of the shutter and the response of the observer. This procedure was repeated as often as the time available for the sitting allowed, the number of successive classifications varying between one and six. The total number of classifications and introspections obtained was two hundred and thirty-two.

TABLE I

The cards of the classification-series, with the correct classification and a description of each card. The first column at the left contains the numbers of the cards, the second column contains their correct classifications, and the third column contains brief descriptions of the figures.

Card number	*Correct classification*	*Description*
	Zalof series:	
1	Not a Zalof (?)	Blue central parts; large central body and short protuberances; convex sides; roughly triangular

TABLE I—*Continued*

Card number	*Correct classification*	*Description*
2	Zalof	Fairly large; very black protuberances
3	Not a Zalof	Roughly hexagonal in shape; moderate size; no protuberances; center red, roughly five-lobed, minus central circular part
4	Not a Zalof	Four protuberances; body squarish; body and protuberances black, center dark gray and roundish, minus the three projecting bodies
5	Not a Zalof	Each pair of terminal arborizations lacks two external fibrils; otherwise figure is Zalof. Red central parts; heavily striated protuberances
6	Not a Zalof	No protuberances; roughly tre-foil in shape; center blue
7	Zalof	Rather small, fine, and light
8	Not a Zalof	Protuberances not bifurcated, and almost absent, each corner of the figure having four finger-like projections
9	Not a Zalof	Protuberances arborize wrongly, dividing into two groups of finger-like projections. Center lacks tri-partite form
10	Zalof	Protuberances very long, relative to size of central body
11	Not a Zalof	Protuberances divide into three (instead of two) groups of tentacles
12	Not a Zalof	Protuberances roughly knobbed at termini, and not arborized; they are relatively very short
13	Not a Zalof	Central parts missing
14	Zalof	Protuberances shortish and roughly striated; triangular form scalene; roughly-formed center
15	Not a Zalof	Protuberances not arborized, but roughly knobbed
16	Not a Zalof	Protuberances absent
17	Zalof	Smallish; central parts uncolored
18	Not a Zalof	Terminal arborizations absent
	Deral Series:	
1	Not a Deral	Left side gray (instead of colored)
2	Deral	Vivid red left part
3	Not a Deral	Lower left straight contour-line missing. Concavity in left contour missing. Leftward point in median line absent
4	Not a Deral	Right side colored (instead of uncolored)
4a	Not a Deral	Orientation altered, figure turned through 90 degrees; concavity of right side lacking
5	Deral	Right side filled in with large ovalish outline-figures
6	Not a Deral	Both sides colored. Point in median line faces rightward (instead of leftward). Peripheral contour of each half ovalish, save for basal regions
7	Deral	Very small
8	Not a Deral	Both sides colored
9	Not a Deral	Point in median line faces rightward. Contour lacks right and left concavities
10	Not a Deral	Detached rays surround colored (left) side
11	Not a Deral	Contour on right incorrect

TABLE I—*Continued*

Card number	*Correct classification*	*Description*
12	Not a Deral....	Point in median line absent
13	Not a Deral....	Upper lobe of left side absent
14	Not a Deral....	Contour of right side lacks concavity and basal projection
15	Not a Deral....	Contour of left side lacks straight line and concavity
16	Not a Deral....	Extreme lower right peripheral contour of left side not straight, but irregularly convex
17	Not a Deral....	Median line lacks point, but has instead a curve
18	Not a Deral....	Left side filled in with splotches of various colors, instead of having uniform color
19	Deral.....	Right side black
	Tefoq Series:	
1	Not a Tefoq (?).	Circular background has irregular patches of color instead of uniform color
2	Not a Tefoq...	Angular central part too many-sided; central irregular design incorrect
3	Tefoq.....	Periphery very irregular
4	Not a Tefoq...	Indentation in lower periphery missing
5	Not a Tefoq...	Periphery perfectly circular; central irregular design absent
6	Tefoq.....	Smallish; background plain
7	Not a Tefoq...	Central part curvilinear, instead of rectilinear and angular. Indentation in lower periphery minus one prong
8	Tefoq (?).....	Periphery perfectly circular
9	Not a Tefoq...	Central (angular) part uncolored
10	Tefoq.....	Angular central part enormously elongated
11	Tefoq (?).....	Periphery has saw-tooth-like projections
12	Not a Tefoq...	Small triangle absent
13	Not a Tefoq...	Angular central body turned through 180 degrees
14	Tefoq.....	Small triangle uncolored
	Kareg Series:	
1	Kareg.....	Very large; irregular; shaded by lines, slightly tri-dimensional in effect
2	Not a Kareg...	Color red; otherwise correct
3	Kareg.....	Smallish; shaded by lines
4	Not a Kareg (?).	Left part divided by vertical axis, and shaded so as to give roughly the effect of two low cones, held base to base and viewed from the side
5	Not a Kareg...	Right side and neck missing
6	Kareg.....	Shaded in grays
7	Not a Kareg (?).	Sides outlined by arcs of perfect circles, and shaded with concentric arcs.
8	Not a Kareg (?).	Left side perfect square, shaded to give effect of pyramid with point toward eye

III. Results

A. Introspective Data. In the case of every observer, the examining of the classification figures embraced a peculiar succession of processes which was obviously dependent on

the experimenter's question: "Is this a Zalof (or Deral, etc.)?" This peculiar succession was characterized by the fact that the attention and regard moved in a more or less rapid course over the regions of the figure which corresponded to those regions of the generalization-group that had been found to contain essential features. Moreover, the behavior of these regions themselves in consciousness varied in a manner which was correlative with their objective resemblance or lack of resemblance to their counterparts in the original group. While the observers thus showed a remarkable uniformity in the general course of their consciousness, they nevertheless differed in many respects, both structurally and functionally. Structurally, the variations consisted in the nature of the imagery which supplemented the observers' classifyings of the figures.[4] Functionally, the variations were concerned with the extent to which supplementary imagery appeared, with the conditions under which it occurred, with the extent to which the course of attention was deflected to the regions of striking variables, and with the relative strength or dominating power of the main coursing of consciousness over the figure (which constituted the process of classification) on the one hand, and of the behavior in consciousness of separate features, on the other. We shall begin by presenting a number of typical introspections of each observer's classifications of the figures; and we shall then present a general description of the processes which constituted the classifications, endeavoring to indicate both the similarities and the differences among our observers. With each introspection we shall include a mention of the time which elapsed between the presentation of the card, and the verbalizing of the judgment.

OBSERVER A

Zalof, Card 3 (November 18, 1912) "No." Time, .5 sec. Introspection: "I simply noted the shape of the figure,—which was round and large. I had no attitude of looking further, but immediately responded 'no.'"

Zalof, Card 5 (December 3, 1912) "Yes." Time, 1.5 sec. Introspection: "My glance went first to the branch on the right; I saw the ends of the branch, and then the center, and started to say 'yes.' My 'yes' almost stopped, when I noted the presence of four branches; at this moment I had a visual image of the original three branches in the figure."

Zalof, Card 7 (December 3, 1912) "Yes." Time, .9 sec. Introspection: "The features of the figure came into my attention very

[4] We shall use the term 'classifying' (unless otherwise qualified) in referring to the total observation of the classification-figure, together with the affirmative or negative judgment in which it culminated.

quickly, one after the other. Immediately I said 'yes.' After that I was aware of a tendency to verify my judgment; this consisted in the appearing of a visual image of a figure of the original series which resembled the figure which had just been exposed, and in my viewing the two images side by side."

Zalof, Card 10 (December 3, 1912) "Yes." Time, 1.75 sec. Introspection: "First of all I was vaguely aware of the whole figure; then I ran my eyes out to the ends of the various branches. The sub-branches terminated in points, and that seemed to 'stir up' my answer 'yes.' As soon as I had given this affirmative response, I was aware of a desire to look at the central parts of the figure,—to see if that center were present. This consisted mainly in a turning of my attention toward that region, together with visual imagery of what the center might have been. I was also aware of a visual image of the first member of the Zalof series, in which the center was clearer than the rest of the figure."

Zalof, Card 11 (January 14, 1913) "Yes." Time, 1.2 sec. Introspection: "I was aware, at the outset, of looking fixedly at the center; my attention was held by the various lines about the center, and this amounted almost to a confusion or a distraction. As soon as I could, I removed my attention from the central region and my glance went to the ends of the branches. I was aware of two groups of branches at the end of each main branch,—I glanced in turn at the ends of each of the three branches,—and then I said 'yes.' The general shape and the presence of the two groups of branches at the end of each main branch meant 'yes,'—meant Zalof. My actual perception of these features gave me my affirmative response."

Zalof, Card 5 (January 28, 1913) "No." Time, 4.2 sec. Introspection: "My eye fell first upon the right-hand part of the figure and I was vaguely conscious of its blackness, although I did not attend to this. Instead my attention immediately went to the essentials of the figure; and I noted that the branch which I was fixating had two groups of tentacles at its end, and that each of these two groups was divided into still smaller ones. I found, however, that these smallest branches were only two in number. I glanced toward the left, and saw that the end of the next branch was the same. I then glanced at the lower branch and found that this also was the same. The presence of these variations in the ends of the branches compelled me to say 'no;' this compulsion consisted in the fact that I tended to turn away from them as from a difference. Then the presence of the black lines extending through the tentacles stood out; this constituted another prominent difference and seemed to add to my tendency to turn away from the figure. The whole situation meant 'no.' I did not take time to observe any other features, but immediately gave my negative response."

Deral, Card 3 (December 10, 1912) "No." Time, 2.8 sec. Introspection: "I was aware of the shape of the present figure; it had two parts, one at the left and one at the right. I called up images of the original figures, which I compared with the percept; I looked at several of them to see if they had this particular shape and size. At that time I was wavering between tendencies to say 'yes' and 'no;' I might have said either. I was aware of hesitation; I was then aware that this percept could be called a Deral, if it were cut in a certain way; I had imagery of the experimenter in the act of cutting it in this fashion. At the same time, I was aware that the images of the original figures did not in any case possess the same

shape as my percept; this fact was the clearest in my consciousness. My answer 'no' followed."

Deral, Card 2 (January 21, 1913) "Yes." Time, 3.4 sec. Introspection: "I had to investigate every part of the figure, because it was so extremely red. My attention went to the redness; I then began investigating the other parts,—the little angle at the right-hand side, the projecting dotted area, and the rest. The little angle of the base of the left-hand side stood out clearly from the straight line at the base of the central projecting part of the figure (right-hand side). The dotted area was remarkably large. In the case of every feature I was aware first of a feeling of familiarity with that feature, and next of a verification of it by comparing it with images of the original series. My affirmative response followed."

Deral, Card 4 (January 28, 1913) "Ye-e-e-s. The color upon the other side is just a deception; the form is the main thing." Time, 1.8 sec. Introspection: "My attention went first to the form. When I perceived its doubleness I was aware of clear visual images of some of the other figures, which I compared with the present one. I knew that they were not the same in all respects, but that they were the same in the essentials. The 'yes' started to say itself and then I perceived the color. My awareness of the color tended to check my 'yes' but it did not constitute enough of a check to make me say 'no.'"

Deral, Card 5 (February 4, 1913) "Yes." Time, 2.2 sec. Introspection: "I attended to this figure in the same way as I had attended to the figures of the original series, in their previous exposure. My attention went first to the two straight lines; these stood out easily and quickly, and no differences occurred as my attention passed across them. The way I perceived the lines,—the ease and quickness with which my regard went over them,—the fact that they demanded no attention—meant 'same.' I glanced at the rest of the figure, seeing the lobes and the central projecting part; my response came automatically; and at the same time, or immediately before, I saw the lines in the figure. These persisted most prominently after the response."

Tefoq, Card 1 (February 18, 1913) "Yes." Time, 1.8 sec. Introspection: "The figure was vague at first; presently my attention went in a half-hearted fashion to the central region, although I did not see this in detail. It then went to the indentation in the lower periphery. I then saw the colored patches; my awareness of this was followed by vocal-motor imagery of saying 'no.' I then turned to these essential things, and made an effort to recall the figures of the original series. I saw that certain features were common; but I was unable to recall another case in which the colored patches on the background were present. These were not essential, however, and I answered 'yes.'"

Tefoq, Card 4 (March 11, 1913) "No." Time, 2 sec. Introspection: "During the first moment the perception cleared up in my consciousness. I then found that the main features of the central region were present; they stood out easily in my attention. I especially noted the little blue object sticking up behind the central region ['blue' triangle]. I then noted the absence of the 'Chesapeake Bay' indentation, and automatically I said 'no.'"

Tefoq, Card 11 (March 18, 1913) "No." Time, 1.6 sec. Introspection: "The periphery of the figure,—the saw-teeth,—stood out

clearly in my attention, and also the plainness and whiteness of the background surface. It never stood out very clearly; I started to say 'no' before it had fully cleared up. I can not recall what the central region was like; I saw it only in a brief glance. I did not look for the 'Chesapeake Bay' indentation."

Tefoq, Card 13 (March 25, 1913) "No." Time, 7.2 sec. Introspection: "At the very outset, I knew that the central part was wrong, but I could not tell what was wrong with it. The progress of my attention was blocked by it; I could not get beyond it, and I examined it part by part, beginning with the decoration upon the end which faced me. This possessed the points which I had observed in the original figures. My awareness of this was almost in the direct perception itself; but there was some comparison of it with schematic visual imagery of this decoration as it occurred in earlier figures. I noted next that the central part possessed depth, as had the central parts of the original series. I began an effort to call up the original figures; I could not recall all of them, and their presence did not seem to aid me. Very suddenly I discovered what the trouble was: I saw the central part inverted; I realized that the wrong end of the 'piano' was facing me. Just at this moment, I perceived that the triangular patch did not stick up from behind the central figure. My awareness that I was looking at the wrong end of the 'piano'* consisted in suddenly seeing the 'piano' turned about, nothing else in the figure being altered. Immediately my negative response followed."

Kareg, Card 1 (April 1, 1913) "Yes." Time, 1 sec. Introspection: "I observed the main outline, which seemed the same as the Karegs, and the fact that it possessed depth; my attention was particularly upon the lines which shaded the figure. My 'yes' followed immediately. After the exposure was terminated, my awareness of the lines continued in visual imagery; there was a vague unfamiliarity about them. The ease and rapidity with which my attention passed over the main form was the sameness; I did not call up a single visual image. The lines were a disturbing element."

Kareg, Card 4 (April 1, 1913) "No." Time, 1.2 sec. Introspection: "The figure lacked familiarity from the outset. It did not look like the other figures. This was present in the hesitancy with which I regarded the form and shape of the figure. While regarding this, I said 'no;' afterwards I was aware of imagery of the figures of the original series, but none of them possessed such an outline."

Kareg, Card 5 (April 1, 1913) "Ye—No." Time, 1 sec. Introspection: "At the very outset, I was aware of the shading and the sides of the figure. This stood out easily and I started to say 'yes.' Then I observed that no smaller right-hand part was present and I said 'no.'"

Kareg, Card 8 (April 15, 1913) "No." Time, 1 sec. Introspection: "First of all I perceived the angles at the top and at the bottom; I observed that the outline was cube-like, with one point facing me. My reaction 'no' followed immediately."

OBSERVER B

Zalof, Card 1 (November 18, 1912) "Yes." Time, 1 sec. Introspection: "At the outset, my attention fastened quite involuntarily

*A had previously likened this central part to an upright piano.

upon the center. I noted the presence of four component forms, my idea of fourness being present in four definite movements of my eyes. I next looked at the three branches of the figure, and noted the bifurcation at the ends, whereupon I said 'yes.' I then observed attentively the blueness of the center; immediately I was aware of a slight catch of my breath, which functioned as a questioning,—'must the Zalofs be red in the center?' I was then aware of a definite visual image of a Zalof of the original series, whose tentacles were similar to those of the card which I had just seen."

Zalof, Card 2 (November 18, 1912) "That is a Zalof." Time, 1.25 sec. Introspection: "My eye fastened upon the center first; then I noted the bifurcations at the ends of the tentacles, and then the tentacles themselves. The color did not reach focal attention until later. The whole gave me an impression of bigness, present in the extensity of my eye-movements themselves. I was aware of a tendency in the muscles of the left hand to twitch, as if to react by tapping; I then gave my verbal reactions. Apparently I did not have the proper reaction mechanism at hand."

Zalof, Card 3 (November 18, 1912) "No." Time, 2.5 sec. Introspection: "At the very outset I perceived that this was a pentagonal figure. My reaction 'no' followed immediately, and simultaneously my attention went to the center and I noticed that there were three main parts of the central body, but also three smaller ones. At the same time I noted the color of the center; this seemed to bring in a visual image of a member of the series, but one with distinct projections."

Zalof, Card 4 (November 18, 1912) "No." .75 sec. Introspection: "The fourness of this figure flooded in upon my attention; it came to consciousness in terms of oculo-motor innervations. I then noted that the branches terminated in bifurcations, and this was followed by a peculiar consciousness, which meant 'not on your life; you won't fool me.' This consciousness is hard to describe; it came out in my belligerent 'no.' Before I reacted I attempted to fixate upon the center; I got only a shadowy dim gray of a circular outline, but no clear impression."

Zalof, Card 6 (November 25, 1912) "That is not a Zalof." Introspection: "My attention went immediately to the inner parts, the outline being less clear. On the basis of the form of these parts I was aware of a tendency to say 'yes.' Their blueness did not seem to interfere with my affirmative tendency. My attention then went to the outline,—to the fact that the corners were smooth. A visual image of an arborized tentacle came up, with auditory imagery of my own voice saying the word 'bifurcation.' Then I was aware of vocal-motor verbal imagery of 'no Zalof,—has rounded corners' and I gave my reaction." (Describe your first affirmative tendency.) "This was partly a muscular innervation in my hand for tapping and partly a vocal-motor verbal 'yes' or 'that's a Zalof.'"

Zalof, Card 9 (December 5, 1912) "That is decidedly not a Zalof." Time, 1.9 sec. Introspection: "My attention went first to the general form, and to the fact that it possessed curves which had not been present in the Zalofs. It next went to the tentacles and I perceived that there was a bifurcation at the end of each tentacle. All of this time I was aware of a growing 'yes'-consciousness; this seemed to consist in a relaxation of my attention, having something to do with eye-movement. It was bound up with change in direction of atten-

tion and relaxation of strain. I then turned my attention in a rather voluntary fashion to the center. Immediately 'no' appeared to my consciousness in auditory and vocal-motor terms. My reaction followed."

Zalof, Card 9 (December 10, 1912) "That's no Zalof." Time, 1.5 sec. Introspection: "My attention went first to the center; and this was not right. I did not react immediately, but waited until my eyes had wandered over the periphery; the periphery was not satisfactory, although I was aware that the tentacles had a slight tendency towards bifurcation. My decision was made as soon as I obtained a clear perception of that center which lacked the three ovular bodies. It was present in a tendency to turn away from the figure and to react; and I think I actually turned my head and body slightly. My awareness that the periphery was not satisfactory consisted in a dim visual image of the form of bifurcation which is characteristic of the original series; it seemed to come to my consciousness along with the visual perception of the tentacle. I was aware of a peculiar attitude of hostility; the Zalofs seem to be good to look at, and the other figures are to be cast out. This attitude was present only in the affective toning with which I threw it out."

Zalof, Card 10 (December 10, 1912) "Yes." Time, 3.2 sec. Introspection: "My attention fastened upon the center, where it remained; the central bodies were not clearly marked out. The figure was so small that I could not see whether there were separate central bodies. After a time I turned to the periphery; I was fairly certain that it was correct, but I investigated each tentacle in turn. My certainty was present in the relief from tension in my chest, shoulders and eyes with which I turned to successive tentacles, and finally back to the center. I was unable to detect more clearly the arrangement of the central parts. I was aware of a 'yes' consciousness,—auditory and vocal-motor of the word 'yes.' I then noted the very decided curve in each of the tentacles and was immediately aware of a visual image of the curve in the tentacles of the first Zalof of the series. The whole process presently dropped out of mind, and that meant that this characteristic was all right. Finally I was aware of a visual image of the tiny Zalof of the series, in which I had been unable to perceive four separate bodies in the center. Thereupon I gave my answer."

Zalof, Card 12 (January 14, 1913) "No." Time, 1.6 sec. Introspection: "Attention at the outset fastened upon the center. I examined it closely; I found that there were not four bodies in the center. My reaction followed immediately. As the curtain was falling the word 'smooth' came to my mind with a tendency to turn toward the corners of the figure; I can not remember now how these were formed, but I am certain that they were smooth and not bifurcated."

Zalof, Card 13 (January 14, 1913) "No, *ma'am*." Time, 2.1 sec. Introspection: "The figure cleared up in my attention,—all black. My fixation seemed to go out to the periphery; then I had to will my attention back to the center. This was very different from the others. I became confused: I had a peculiar bodily feeling as though I were suspended in the air. For a moment I lost my *Aufgabe*,—I forgot what I was to do with the figure. Then I think that I superimposed a visual image of a correct central form (uncolored) over the center of the percept; my knowledge that this was nothing like the Zalof came out in my 'no, ma'am.'"

Zalof, Card 2 (January 21, 1913) "Yes." Time, 2.2 sec. Introspection: "My first reaction was negative; the blackness and the heaviness of the figure compelled my attention, striking me with a strange new feeling. This strangeness is difficult to describe; it involved a shallower breathing, a fixating, and a kind of a surprised 'no' in vocal-motor imagery, with an explosive innervation back of it. From this time on my attention traveled about the figure; I noted the general triangular form and the tentacles; I examined the center carefully and found four red bodies. Still my attention tended to fasten upon this heavy shading at the terminations and the feeling of strangeness persisted. Visual images of figures of the original series which contained decided variations in the shading came to my consciousness; at this point I was aware of a great deal of satisfaction and of a release of my attention from the heavy shading of the figure. My reaction followed."

Zalof, Card 15 (January 21, 1913) "No, sir." Time, 3.2 sec. Introspection: "My attention went to the general form of the figure,—the triangular body, which agreed with the figures of the series. Then my attention went to the central parts, which were properly composed of four bodies. Then my eye traveled along the periphery and I noticed the ends of the tentacles, which were entirely wrong; I realized this before any visual image of other bifurcations appeared. I was aware of auditory imagery of the word 'bifurcations' and of a sort of disgust; I then verified and compared my percept with visual imagery of one of the larger figures of the original series. My reaction followed." (Describe your consciousness that the triangular body agreed with the members of the original series.) "I was aware of imagery,—visual and other,—of being seated at the other apparatus and being shown the first member of the original series. The bodies were similar in the image and in the percept; my consciousness did not remain upon this feature, but floated smoothly to the next figure."

Zalof, Card 17 (January 27, 1913) "No." Time, 2.2 sec. Introspection: "My eye travelled over the contour of the figure, and it was correct; I noted the bifurcations, and the fact that my eye passed on without stopping meant that the form was correct. I was aware of pleasantness, and of a tendency to react with 'yes.' Then I looked at the center; the form of the central bodies was perfect. Then the word 'red' appeared, with questioning inflection, and my reaction was 'no.' Immediately several images of Zalofs in which the center was invariably red flooded into my consciousness."

Zalof, Card 5 (January 27, 1913) "Ye-e-s." Time, 3 sec. Introspection: "The bigness, and the coarseness of the figure seemed to give me a negative tendency. I was aware of verbal imagery of 'no.' Then I began a detailed investigation of the figure; my eyes went to the center, which was approximately correct, and then to the periphery. The periphery was right; my awareness of this came in terms of auditory imagery of 'bifur—,' the word remaining incomplete. Then my attention returned to the center and I looked at the three bodies which project in the direction of the tentacles; I could make these out although they were not very well differentiated. The middle body was there, and also not well differentiated. The color was proper. I gave a hesitating reaction."

Zalof, Card 17 (January 20, 1913) "It is. Oh, no! It isn't! It isn't!" Time, 11 sec. Introspection: "I became aware of the form on the first glance. It was pleasing. I glanced at the center; this

seemed to satisfy me, as my attention passed readily away. My glance went out to the tentacles; they were correctly formed. I reacted instantly. Then came a visual image of the figure, and I realized that the center was not red but black. My attention for the first time semed to focus upon the center, and the word 'red' rushed in. My negative reaction followed immediately. Afterwards I was aware of visual memory-images of Zalofs with red centers, and of auditory imagery of having described the Zalof as always having red centers."

Zalof, Card 18 (February 6, 1913) "No." Time, .8 sec. Introspection: "My eye fell first upon the periphery; the tentacles had no arborized ends. My decision was ready at this instant; yet I was aware of a sort of inhibition which seemed to consist in a mechanical carrying out of my scheme of observation. My eye traveled to the center before I reacted. Immediately after my negative reaction, or with it, I was aware of a visual image of bifurcated ends which seemed to be superimposed upon the percept. The smoothness of the ends seemed to be a positive thing which simply entered consciousness and set off my reaction almost reflexly."

Tefoq, Card 5 (January 27, 1913) "No." Time, 1.4 sec. Introspection: "My attention went in turn to the periphery, to the blankness of the circular background and to the end of the central part. I was aware of visual imagery of the irregular leaf-like form of the periphery in one of the original Tefoqs. My attention riveted upon the white blank end of the central 'steps' [the angular central figure] and my 'no' followed immediately. I think that 'hi—,'—the first of the word 'hieroglyphic' [B's name for the little irregular design in the center of the angular central figure] came to consciousness in auditory imagery, or in a setting of my mouth for pronouncing the sound; this was very vague and non-focal."

Tefoq, Card 1 (February 3, 1913) "Yes." Time, 5 sec. Introspection: "My attention went first to the stair-step central figure. This was all right. My regard then passed to the indentation in the lower periphery and followed around the periphery. I then noticed the design in the end of the central part and this was likewise correct. I was aware of a tendency to react, which was immediately followed by focal attention upon the figures on the background part. This attention was accompanied by a parting of my lips, an in-take of breath, and a leaning toward the card. Presently I was aware of a visual image of a member of the original series, in which much shading was present in the background part of the figure. Then I turned to my essential features once more, and went over them three or four times, noticing the design on the end of the central figure, the periphery, etc. All of this time the figures on the background of the percept were prominent in my consciousness. Finally I dragged myself to react."

Tefoq, Card 3 (February 3, 1913) "Yes." Time, 2.2 sec. Introspection: "My eye first fell upon the form of the central part of the figure. The word 'green' came to mind. My attention passed easily from this central region, and I noticed the blue triangle, from which my attention again shifted easily. I observed the design in the end of the central part and said 'yes.' The outline was in the fringe of my consciousness throughout."

Tefoq, Card 4 (February 10, 1913) "Yes." *No!!*" Time, 2.2 sec. Introspection: "My attention passed over the central part of the figure; during its course, the following verbal imagery appeared, in

vocal-motor terms: 'steps washed in green;' 'triangle blue;' 'design,—' then 'yes.' Afterwards I was aware of a visual image of a figure, in which my attention was upon the lower outline and upon the absence of the indentation. Immediately my 'no!!' followed. Before or during this 'no!!' I had very good visual imagery of several indentations in their proper form."

Tefoq, Card 6 (February 17, 1913) "Yes, that is a nice little Tefoq." Time, 1.8 sec. Introspection: "I noticed at the outset the relative smallness of the stair-step form and the bigness and blackness of the outline. This was followed by a rigidity of body which constituted a somewhat negative reaction. My attention then went to outer parts of the figure, and I was aware that these corresponded to my definition of what the outline should be. The word 'inset' occurred in auditory imagery of my own voice, and I was satisfied as far as the periphery was concerned. I was then aware of auditory and vocal-motor imagery of 'green wash' and I noted its presence. I then noted the tiny blue triangle and the design in the end of the central part. I drew a little closer and was aware of pleasantness, just before I voiced my decision."

Tefoq, Card 7 (February 17, 1913) "No." Time, 1.4 sec. Introspection: "At first my attention went to the inset in the lower periphery, then to the green wash on the side of the central body and then to the bright blue triangle. I was aware of an affirmative tendency, and almost had vocal-motor imagery of 'yes.' Then my attention fell upon the curve, where there should have been sharp corners. I was aware of a decided shock, and of kinaesthesis of closer scrutiny on this feature. Then I reacted with 'no' before I observed whether or not the design was present in the end of the central figure. I think there was no design."

Tefoq, Card 10 (February 17, 1913) "Yes." Time, 3.6 sec. Introspection: "At first I was aware of extreme interest in the figure. I glanced it over quickly, and from this moment there was a consciousness that in spite of the strangeness of the figure, it would turn out to be all right. This consciousness, I think, consisted in a quick grasping of all of the essential features. Then I began deliberately noting each detail; first of all the outline. Before my attention went to the other details I had a visual image of one of the Tefoqs, in which the central part extends beyond the right periphery; and also auditory recall imagery of having mentioned to you that the outline need not include the whole of the step. The auditory imagery was not clear and detailed. Then my attention went to the 'step' (central figure) itself. I noted that the form and color was right. 'Green' was present in auditory and vocal-motor terms. I noticed the outline and the design in the end, and then came my reaction."

Tefoq, Card 11 (February 24, 1913) "Yes." Time, 2.6 sec. Introspection: "At the start I was aware of dissatisfaction. I could not remove my attention from the periphery; it remained there, and at the time I was aware of a certain amount of tension in my chest, eyes and forehead. I seemed to drag my focus away from the periphery by main force. I then turned to the central figure and began going over my criteria,—the greenness, the blue triangle, the design in the end of the steps. Then my 'yes' followed."

Deral, Card 1 (March 3, 1913) "No." Time, 1.9 sec. Introspection: "My attention went over the entire form of the figure and the foot on the right-hand side and the humps; at the same time I was

aware of a visual image of the first Deral which had about the same size and form as the present figure. The word 'fish' was also present. What was most focal in my mind at first was the visual perception of the form, the immediate and ready slide of the attention from one figure to the other, and the absence of a tendency to hesitate or to make comparisons. At the close of this survey I started to say 'ye—,' that being present in vocal-motor imagery. Then my eyes went to the left-hand figure, and the word 'black' appeared; hesitation followed, and then the words 'not colored,' and then visual imagery of colored figures."

Deral, Card 2 (March 13, 1913) "Mm—hm."[5] Time, 3 sec. Introspection: "My first tendency was negative. The 'Mm—hm' started to be 'Mm—mm.' At this time my attention was on the red color; and clung tenaciously to that color. Instead of giving the negative reaction, I busied myself with the other features; I found myself going over the figure very carefully. I first noticed that the right-hand figure had cilia. Then I attended to the outline of the right-hand figure and I was conscious that the cilia ran all about the periphery. I noted the smoothness of the left-hand figure; then my eye passed downward to the bottom of the left-hand figure and I noted that it stood on a triangle. At this time I was aware of auditory imagery of 'triangle at the bottom.' The bright red coloring was clear in my consciousness. My attention then went again to the form of the right-hand figure, in order to note whether the right-hand side had a bowed form. I found that it did. Still, my affirmative reaction was inhibited. The figures did not seem to stand at the same angle as the rest of the figures. This occupied my attention for a perceptible length of time. Finally I reacted affirmatively." (Describe your statement 'in order to note whether the right-hand side had a bowed form.') "My observation of the outline of the right-hand figure was initiated by a visual image of a member of the series in which that outline was bowed."

OBSERVER C

Zalof, Card 1 (November 23, 1912) "No." Introspection: "My attention went to the triangular form and the three branching-off processes with the fibroid processes at the ends. When I looked at the blue color, I was aware of some hesitation regarding my own definition and of wondering whether color should have been made an essential element. My observation of the triangular arrangement was attended by a vague visual image, the form of which was defined not by lines, but by something kinaesthetic, of the nature of empathy; I was aware of a feeling of being stretched out like a starfish; this consisted in a slight pull of my shoulder muscles and a feeling of the center being located in my chest. It was very fleeting. My wondering whether the definition should have made color an essential element was for the most part present in vocal-motor verbal terms, to the effect that the definition might well include only the triangular arrangement and the branching processes, and leave out the matter of color. I had a vocal-motor tendency to use the phrase 'too obvious,' meaning that my definition was too obvious when based on color. This consciousness was not definitely evolved at the time; it was simply 'too obvious.'" (What was the immediate antecedent of your reaction 'no?') "It was focussing on the part of the figure

[5] 'Mm—hm' is a colloquialism of affirmation, 'mm—mm,' of negation.

colored blue. From the very first I had been aware of a negative attitude; it was rather definitely localized in the muscles between my eyes, as if I were squinting and wrinkling my forehead. There was also a slight unpleasantness, although 'strain' expresses the consciousness better. Then came the consciousness that I would like to revise my definition."

Zalof, Card 2 (November 23, 1912) "Yes." Introspection: "I was aware of a fragmentary and unclear empathic kinaesthesis or attitude, similar to the one which I described in connection with the first card (card 1). The vocal-motor 'yes' came before I spoke, and it followed very closely upon the kinaesthesis."

Zalof, Card 3 (November 23, 1912) "No." Introspection: "The processes were very fleeting. I had a tendency to say 'no,'—strains in my throat muscles,—immediately after you exposed the figure. Then came a sort of internal 'why,' partly vocal-motor. Then voluntarily my attention moved around the figure, following its outline; there was a feeling of no angles, present particularly in vocal-motor terms of 'angles' and partly in a kinaesthesis of eye-movement. At the end of this survey of the thing, my reaction 'no' occurred. The first 'no' was much more vivid and intensive than my finally-spoken 'no.'

Zalof, Card 4 (November 23, 1912) "No." Introspection: "I was aware at the outset of a visual image of the words 'no red,' in my own handwriting, held off at a distance; and also of a kinaesthetic pull over to the left. My feeling of empathy recurred, but its balance was disturbed by a pull to the left. Then, with voluntary attention, I fastened my eyes upon the center of the figure; then came a vocal-motor tendency,—'that bally definition.' I was aware of unpleasantness; and a vocal-motor 'no' grew up slowly, beginning with a sensation of pressure at the lips and with a slight bending over toward the right side. Then came a kinaesthesis at the back of the tongue, which held for an appreciable period of time. Then 'no' was pronounced slowly. This feeling of disturbed balance and unpleasantness persisted throughout; when I gave my reaction it disappeared."

Zalof, Card 6 (December 6, 1912) "No." Time, 1 sec. Introspection: "My attention went to the general form of the figure, and the following vocal-motor verbal process went on: 'general form has no distinct off-shoots; points are not equidistant from center; color blue; background covered with dots, no repetition, in center, of general pattern of off-shoots from periphery.' This vocal-motor process was to some extent innervation,—'blue' came out,—but it was mostly a feeling of strain and slight tongue movements. I was also aware of kinaesthesis in my left hand of pointing to the dots; they impressed me as being new, and their newness consisted in their visual clarity itself and in this kinaesthesis."

Zalof, Card 7 (December 6, 1912) "Yes." Time, .9 sec. Introspection: "I was aware at first of a visual image of a larger pattern of this same stimulus, and my affirmative reaction came immediately after this image; it appeared first in the form of a slight bending forward at the back of my neck, and the vocal-motor 'yes' came immediately. After I had pronounced the 'yes' I was conscious of the fact that my attention to the stimulus had been concentrated entirely upon the periphery of the design. This was known in terms of a recurrence of kinaesthesis of eye-movement which had been

present during my observation of the figure; a vocal-motor strain,—'why didn't you look in the center?' appeared, together with a visual image of a large, thickened center formation. Afterwards came a visual image of the center of the stimulus, which was merely red; all I could get was the color, and not the form. Along with it came a kinaesthesis of fixing my eyes upon the center, and a faint unpleasantness."

Zalof, Card 8 (January 31, 1913) "Yes." Time, 1.3 sec. Introspection: "I observed in turn the outlines of the central part, the red color, and the three main arms. With this came a kinaesthetic feeling of assent in the back of my neck,—a kinaesthetic image of nodding."

Zalof, Card 9 (January 31, 1913) "No." Time, 1.2 sec. Introspection: "My attention went to the lumpy, irregular outline, the blueness, and the ends of the tentacles. With my attention to the form of the ends of the tentacles, my negative response began, as simply the closeness of my attention. Just as I said 'no' I was aware of a definite visual image of a large, very simple Zalof."

Zalof, Card 11 (February 18, 1913) "Yes." Time, .8 sec. Introspection: "I first focused upon the center of the card. There was a quick upward eye-movement, and vocal-motor imagery of 'two arms.' Immediately the reaction followed."

Zalof, Card 13 (February 18, 1913) Shakes head. Time, 1.4 sec. Introspection: "At the very outset I was aware of a vocal-motor tendency to react 'yes,' followed by an inhibition which took the form of a tongue movement; at this time I had a feeling that something was absent, and then the reaction 'no' appeared in vocal-motor terms. I gave the reaction, and then came a vocal-motor verbal image of 'red' and a visual image of a red splotch with a vocal-motor 'Zalof.' My feeling of something absent seemed to be a concentration upon the center of the figure."

Zalof, Card 5 (February 25, 1913) "Yes." Time, .8 sec. Introspection: "My attention focused upon the upper right-hand arm, the rest of the figure being present in peripheral vision. 'Yes' came up in vocal-motor imagery, and my reaction followed immediately."

Kareg, Card 2 (March 11, 1913) "No! Mercy, that's funny!" Time, 3 sec. Introspection: "At the very first I was aware of a strong tendency to react 'yes,' present in considerable innervation, and moving of the tongue. My attention then centered upon the connecting structure, and I was aware of a strong kinaesthesis in my neck of having my head bent in the position of the figure. This was unpleasant. At the same time I was aware of a visual image of a clam with its protruding neck bent down. Just before I reacted I had a visual image of the printed words 'in spite of' and some awareness of 'in spite of stronge resemblance.' The words 'strong resemblance' were present in faint vocal-motor terms. My reaction followed. The head of the figure ought to go out straight instead of being bent down in a curved line as it was in this figure."

Kareg, Card 8 (March 25, 1913) "No." Time, 2.4 sec. Introspection: "I noted the form of the figure, with the awareness that the large body was on the right-hand side. I was also aware of a visual image of the turtle-like Kareg [of the original series], the large portion of the figure being on the left; at the same time came the vocal-motor imagery of 'they are all like that.' My eyes were focused on the figure on the left where they tended to remain. A

vocal-motor strain for saying 'no' appeared and then the spoken reaction itself."

Deral, Card 1 (April 15, 1913) "Yes." Time, .8 sec. Introspection: "My attention went to the lower part of the right-hand figure, and then the line of regard moved upwards obliquely in a broad bend to the upper left-hand part of the figure. At the angle in the line between the left and right-hand figures I was aware of a slight kinaesthesis of a hitch or jerk, and then of satisfaction. This constituted a consciousness that my oblique line of regard had taken in all of the angles which I had discovered in the figure. (At present I am not at all sure that it did.) My reaction followed immediately."

Deral, Card 4 (April 15, 1913) "No." Time, 4.2 sec. "As I observed this figure, I was aware that it was tilted, that it did not stand square. I had a kinaesthesis of whirling and dizziness and of decided tilting of my whole body, of my head being nearer the ground than normal. The kinaesthesis came towards the last of my observation. My negative reaction followed."

Deral, Card 8 (April 15, 1913) "Ye-e-es; I don't know." Time, 1.2 sec. Introspection: "My first perception of the figure was followed by a feeling of balance, a consciousness that the figure had the proper attitude. This kinaesthesis of balance was strongest in my right hand, and it consisted in a sense or awareness of taking hold of the figure and settling it squarely, in an upright position. Immediately I said 'yes;' afterwards I was aware of a lingering focus upon the upper right-hand part of the figure which seemed to have a finger-like structure not present in the Derals. I dwelt upon color in my primary memory image of the figure; I was aware of hesitation and of a vocal-motor image of 'color?' with decided questioning inflection."

Deral, Card 1 (April 29, 1913) "Yes." Time, 12 sec. Introspection: "At the outset I was aware of a strong tendency to react negatively. This came as a vocal-motor image of 'no' and a kinaesthetic tendency to focus upon the uncolored left-hand side of the figure. Then came a kind of focusing both of my eyes and of the direction of my head upon the lower part of the figure. A visual image of one of the Derals which I had just been shown came up rather clearly; I was aware that there was no color in my percept and that certain typical angles were present in both percept and image. [During the previous exposure of the series, I had had a vocal-motor experience of dividing the Deral into two types, as regards the angles; in one type the acute angle is very acute, and is lower in the figure; in others, it is less oblique, and further up in the figures.] A vocal-motor image of 'acute angle' now occurred, and a wave of recognition which consisted in a strong affective toning, —pleasure, with a strong gasp outward,—and considerable empathy of sharp bending or contraction. Then came a definite affirmative kinaesthesis in my head, of nodding, and in my hand of a waving gesture. The vocal-motor verbal image of 'yes' appeared. Then came the reaction; afterwards I was aware of strong negative and strong affirmative tendencies which seemed to project themselves respectively into the two sides of the figure. I had a visual experience of seeing a series of schematic lines on the left which meant no and another one on the right which meant yes."

Deral, Card 2 (April 29, 1913) "Yes—no!" Time, 2.8 sec. Introspection: "My attention went to the color. After my initial focus

upon color, I was aware of a lapse in consciousness, of a sort of a break with no sense of the problem. At this time I had an affective toning of interest. Then I focused my attention on the left by a voluntary effort which appeared in a kinaesthetic shock. A vocal-motor image of 'acute' occurred, as well as kinaesthetic and visual imagery of balancing. I had a visual image of a figure as if hanging in space, the acute angle being supported by a wire and the two halves of the figure balancing perfectly. At the same time I had a kinaesthesis of balancing myself which was localized in the arms and hips. Then a vocal-motor verbal process 'belongs to first type.' Then my reaction 'yes.' Then the figure was withdrawn; my eyes looked downwards. Presently came a strong visual image of the first figure I had seen. I saw clearly the lower part of the figure and noted that the lower extremities of the two halves were separated widely. At this I was aware of a feeling of great strain in my eyes, as if they were diverging; my focus changed from the floor, with an almost painful feeling of my eyes being stretched apart. The kinaesthesis was actually stronger than the sensation of the change of focus. Immediately I said 'no.'"

Deral, Card 5 (April 29, 1913) "Yes." Time, 1 sec. Introspection: "My attention went to the base of the right-hand side. I was then aware of kinaesthesis of my eyes moving up the line adjoining the two halves; this was a muscular pull of my eyes following the line. Therewith I had a familiarity,—a memory of a movement like that in the past. The kinaesthesis was an immediate sort of a thing, an easy sensation, as a repetition of a movement made very recently. My reaction followed."

Deral, Card 12 (April 29, 1913) "Yes—not sure." Time, 1.2 sec. Introspection: "I based my decision upon the correct position of the foot. At the very outset my attention focused upon the lower right-hand part. This focusing was followed by my reaction 'yes.' After the figure was withdrawn, a visual image of it persisted. My attention in the image went to the union between the right-hand and left-hand sides; I do not think that the right-hand figure is inserted far enough into the left-hand figure. After my 'yes' a vocal-motor 'no angles' followed, attention passing to a visual image of an acute angle running into a mass of something. The acute angle was clear, but the mass was foggy and cloudy."

OBSERVER D

Zalof, Card 3 (November 27, 1912) "It is not." Introspection: "I was aware of a visual image of one of the figures of the series, as soon as my eye fell upon the exposed figure. The image had a compact form, similar to that of the present figure; it was perhaps the seventh or eighth member of the Zalof series. I found my eyes moving about the margin of the exposed figure, and with the movements I counted the sides,—'one, two, three, four, five.' The sides were not sharply differentiated, but the arrangement was pentagonal. As soon as I became aware of this fact,—the counting, the pentagonality,—my negative response followed of itself."

Zalof, Card 5 (November 27, 1912) "It is." Introspection: "As soon as my attention fell upon the figure which was exposed, I had vague and fleeting visual images of several members of the original series. None of these images represented compact figures; all of them had elongated projections. I was aware of slight pleasantness, and my affirmative response followed. Immediately afterwards, I

was aware of doubt and unpleasantness, together with an awareness that the terminal projections did not agree with those of the members of the series. This last awareness consisted in fleeting visual images of the terminal processes of the original series, together with an awareness of the fact that the processes which I perceived did not correspond. I was aware of vocal-motor imagery of the word 'flipper,' as I attended to the visual images of the projections which I had just perceived; they were more like flippers than they were like the projections of the original Zalof figures."

Zalof, Card 7 (December 4, 1912) "It is." Time, 1.8 sec. Introspection: "I was aware at the outset of a rapidly alternating series of visual images of three of the original series. One of these images had very long arms, and I could see the pair of branches at the end of each arm. Another had arms of intermediate length. The third was much more compact than either of the others. All of this time I was conscious of the general shape of the present figure, and of its pair of terminal branches; my attention alternated rapidly between the percept and the imagery. My eyes passed in this way from the center to each terminal process, and I found that the paired arrangement was present in every case. I was aware of slight pleasantness, but of no intensive degree of strain or tension. Immediately after completing the fixation upon the ends of the branches my response came involuntarily."

Zalof, Card 9 (December 4, 1912) "I am somewhat in doubt." Time, 3.25 sec. Introspection: "First of all, I observed the general shape of the figure.—the fact that it had three arms. My attention went to the ends of the arms, and I found that smaller branches were present, and grew out of the two sides of each end; hence they exhibited a bi-partite arrangement. But I also observed that the arrangement was not that of a forking pair of branches at the end of these end-arms. I was aware of hesitation; I looked over the figure several times, always coming back to the ends of the branches, where I observed the bilateral arrangement of the terminal processes. I had a visual image of the first card, which clearly contained the common characteristics. Presently I said 'I am in doubt.'"

Zalof, Card 10 (December 4, 1912) "It is unmistakably a Zalof." Time, 2.45 sec. Introspection: "I was clearly aware of sweeping my eyes first to the upper left-hand corner, then to the right-hand corner, and then to the lower side; in each case I observed that the terminal pair of branches was present. This fact was in the focus of my consciousness. I was less clearly aware at the time of the triangular form of the figure, and also of the fact that the figure was very irregular. I was aware of no pleasantness or unpleasantness and of no tension. The dominant thing was the fact of the terminal branches; and I responded affirmatively."

Zalof, Card 2 (December 11, 1912) "It is." Time, 3.75 sec. Introspection: "I had not a high degree of certainty. First of all I observed the triangular form, then the bi-partite arrangement of the terminal arms. I was briefly aware of red coloring. Most of the time my attention was devoted to observation of the terminal processes. This observation was accompanied by a *Bewusstseinslage* of doubt and hesitation; and finally I found that I had responded affirmatively, without having deliberately made up my mind to do so. I believe that my lack of certainty was due to a doubt as to how many processes must be present at the ends of the branches

of the Zalof figures." (Describe your *Bewusstseinslage* of doubt.) "This consisted in a complex mental process which was dominately emotional in character and describable in some such terms as doubt, uncertainty, confusion and the like." (What was the emotion?) "Neither of the terms pleasant nor unpleasant does justice to the facts." (What other contents were present?) "As I remember it, the affective component was unpleasant; the other components of uncertainty and hesitation I can not now describe fully."

Zalof, Card 8 (December 11, 1912) "It is not." Time, 3 sec. Introspection: "My first glance at the figure revealed its general form. Then my attention concentrated upon the terminal arborizations, and I was distinctly aware of passing my regard from one corner of the figure to another, and of pausing at each corner to examine the number and arrangement of the terminal processes. I found the arrangement to be perfectly regular, and in fours; moreover, the minute terminal arborizations which I found in the original figures were now lacking. My consciousness of the regular arrangement and of the absence of minute terminal arborizations was followed by my negative response."

Deral, Card 1 (February 12, 1913) "Yes,—it all depends upon what is the color of the left-hand side." Time, 8.4 sec. Introspection: "I was aware of looking for certain characteristics,—the notch, the straight side, the color, and the further extension in a posterior direction of the colored side. My awareness of these characteristics was present in vocal-motor verbal terms. I found all of them excepting color; at first I was aware of a tendency toward a negative reaction; this was an emotional sort of a thing which I can not now describe. Then there appeared a series of vague and sketchy vocal-motor images of which the following is the purport: 'Yes, it is gray; but I think I can find a little blue in that gray, so I will say yes.' The verbal imagery was much more vague and sketchy and fragmentary than these words indicate. My attention was on the left-hand side of the figure."

Deral, Card 4 (February 19, 1913) "No." Time, 5 sec. Introspection: "I was aware of an *Aufgabe*,—a definite set or tendency,—to look for color on the left-hand side. I noted that this side was white but there was no tendency to react. My eyes swept to the other side which I saw was colored, a violet color; again there was no tendency to react. I began to seek for confirmation of other characters; the rectilinear 'snout' region at the base of the right-hand side attracted my attention. From the 'snout' characteristic my attention returned to the left-hand side; I was aware of a slight shock when it proved to be gray. My negative response followed."

Deral, Card 5 (February 19, 1913) "No." Time, 6.6 sec. Introspection: "I was aware of an *Aufgabe*,—a tendency to look for color on the left side. I found color in this region. Next I observed the two rectilinear sides; I was conscious of them only for a moment. My attention was next attracted to the right-hand side, where I became aware for the first time that the hairs were absent. I then tried to remember whether hairs were always present in the original figures; this consisted in a tending to say, repeatedly, 'did it have hairs?' I almost spoke these words aloud. Before the problem was settled my attention was attracted to the blotches on the right-hand side of the figure and I reacted immediately in negative fashion."

Deral, Card 8 (February 26, 1913) "It is not." Time, 3.2 sec. Introspection: "First of all, I noted the presence of hair around the border; and I tended to react affirmatively. As far as I can remember, this tendency consisted in an internal and organic welling-up; it also consisted in a tendency to reach out my right-hand, which was lying in my lap. My attention then went to the left-hand side, where I found the rectilinear edge. My attention paused. It then swept back to the right side which I found to be colored. The next thing I knew I had reacted negatively."

Deral, Card 11 (February 26, 1913) "Yes, I think so." Time, 7.4 sec. Introspection: "First of all I examined the color, then the rectilinear side on the colored half, and then the short rectilinear side at the base of the uncolored half. I next noted the dots on the uncolored half and examined these very carefully, noting that they were dots and not hairs. Finally I reacted positively with much confidence; this confidence consisted largely in pleasantness. As soon as I had reacted, I remembered visually that this figure had possessed no cilia; immediately I added 'I think so' to my response."

Deral, Card 12 (February 26, 1913) "Yes." Time, 5.6 sec. Introspection: "First I attended to the hair on the right side. Then I looked at the left-hand side. I found numerous short hairs in parallel rows. Then I attended to color, and then to the rectilinear 'snout' at the base of the right-hand side. All of this time I was aware of an increasing feeling of pleasantness; and finally I found that I had reacted with a good deal of confidence. Afterwards I remembered that I had failed to note whether the notch was present and also the long straight side in the left-hand periphery."

Deral, Card 13 (April 16, 1913) "Yes." Time, 6 sec. Introspection: "My attention went first to the left-hand side; I remember that it was blue and very much smaller than the right-hand side. I was next aware of a series of three visual images of figures which I have seen in the original series, together with vocal-motor verbal imagery of 'rectilinear side.' Then followed a period of hesitation, during which each of these visual images was in turn compared with my perceived figure,—*i. e.*, each image was in turn projected beside the objective figure. I found in each case that both image and percept possessed two rectilinear sides; in each case the coloring was on the appropriate half. Finally I found that I had reacted affirmatively."

Deral, Card 17 (April 16, 1913) "I am in doubt." Time, 4 sec. Introspection: "I first observed the left-hand side and found it colored; my regard then passed to the right, which I found to be covered with dots. I then noticed the rectilinear side of the anterior region of the left-hand part. My regard then swept to the right and I observed the lower rectilinear side. As yet I was aware of no tendency to react affirmatively. Then my eyes swept back and I found that the median line was rounded and not pointed as it usually is. I hesitated, and finally replied 'I am in doubt,' because I could not remember whether the notch must always have a point." (Describe your hesitation.) "I was not aware of visual images. My hesitation simply consisted in a tense uncertainty and suspense, which was unpleasant. It was not a bodily tenseness."

Deral, Card 18 (April 16, 1913) "Gee whiz! I am in doubt." Time, 8 sec. Introspection: "My attention was first attracted to the colored half, where it was held for a moderate interval. My regard then swept across the figure, and I noticed that the other half was

uncolored. I observed next the two rectilinear sides and then the notch. I became aware of doubt and tenseness; presently my regard and attention returned to the colored left-hand part. I was aware then of hesitation, which amounted almost to a mental paralysis; my regard could not be moved, and an inhibition of some sort occurred. I was not aware of any effort to compare the colors with those of the members of the Deral series, nor was I aware of any verbal imagery of 'uniform color' and the like. My awareness of the color was accompanied simply by this mental tension and unpleasantness. I then gave my reaction."

Kareg, Card 3 (March 5, 1913) "Yes, I think so." Time, 10 sec. Introspection: "First of all my attention was attracted to the left-hand part. I then saw the polylateral form, but I observed that one of the sides was concave. This concavity attracted my attention for a considerable time, and my observation of it was accompanied by slight tension and unpleasantness. My eyes then swept to the connecting section and then to the right-hand part. Presently they returned to the concave side. I noted the greater thickness at the center than at the periphery, and finally responded affirmatively, my uncertainty having to do with the concave side."

Kareg, Card 5 (April 24, 1913) Observer turns away. Time, 1 sec. Introspection: "My glance fell first upon the region of the left-hand side, which ordinarily adjoins the upper boundary of the connecting part. From this point I started to count; and I saw that the rest of the figure was lacking. Nevertheless, I later continued my counting; this may be explained perhaps by the fact that the sides were so well-differentiated. I was clearly aware of the presence of six sides."

OBSERVER E

Zalof, Card 2 (November 18, 1912) "Yes." Introspection: "My attention went in turn to the triangular body, the limbs, and the red nucleus. In each case, my impression was accompanied by a vocal-motor verbal image, in the first case of 'triangular body,' then 'three limbs breaking up at end,' and finally 'red nucleus.' At the time of my observation of the central nucleus, I had a visual image of the central parts, the circle surrounded by the pear-seed-shaped bodies. When that came up, I unhesitatingly said 'yes.' Almost from the beginning I was aware of a tendency to react 'yes,' in vocal-motor terms."

Zalof, Card 3 (November 18, 1912) "No." Introspection: "As soon as my regard fell upon the exposed figure, I was aware of a vocal-motor verbal image of 'three limbs branching at end' and also of a visual image of a member of the original series, which had three long limbs. I then had a vocal-motor tendency to react 'no.' Then I became aware of the nucleus; I observed this long enough to see that it contained five parts. My negative reaction followed."

Zalof, Card 4 (November 18, 1912) "No." Time, .75 sec. Introspection: "At the very outset I was aware of a vocal-motor image of 'three limbs;' then my perception of the figure became clearer; almost immediately I had a vocal-motor image of 'four limbs' and also an image of 'no red nucleus.' My 'no' followed upon my perception of the four limbs."

Zalof, Card 7 (November 25, 1912) "Yes." Introspection: "At the very first moment, I decided that the figure was a Zalof. This

decision followed upon my perception of the general form and the red nucleus, and it consisted in a comparison of my percept with a visual image. A vocal-motor 'yes' appeared, but was inhibited by a closer observation of the nucleus. The visual image became clearer in consciousness than my actual percept, and I was aware of turning my attention from the visual image to the percept, and of examining the nucleus. This examination was difficult on account of the small size and indefinite drawing; but after I had observed the center, I decided that it was a Zalof and responded with 'yes.' Just before the stimulus disappeared I noted that each arm split into two terminal divisions. I was aware of a vocal-motor image of 'three arms.'" (Describe your first visual image.) "It was similar in form to the stimulus. It was a vague sort of a thing, and had rather long tentacles. My first vocal-motor 'yes' occurred before this visual image became very clear in consciousness." (Describe your last decision that it was a Zalof.) "This was nothing more than comparison with my visual image."

Zalof, Card 8 (November 25, 1912) "No." Introspection: "I observed the shape of the figure,—the triangular body, the three tentacles,—and was aware of a vague visual image of a Zalof. With my awareness of the form, I had a vocal-motor image of 'yes.' My eyes then focussed upon the nucleus, and the visual image cleared up with respect to its nucleus. A vocal-motor image of 'not similar' occurred. The rest of the time before my reaction was taken up in an examination of the center of the stimulus, in an effort to find whether anything occurred similar to the center of the image. The lines in the center of the stimulus were confused, and I could not be sure as to the nature of the central parts. My examination was accompanied by strain, which was localized in my eyes and forehead; I finally found that the perception did not correspond to my visual image, and I reacted negatively."

Zalof, Card 10 (November 25, 1912) "Yes." Introspection: "My awareness of the shape of the stimulus was accompanied by a visual image of a very long-armed Zalof. The stimulus had no triangular body; it was all arms, and I was aware of a tendency to say 'no.' My attention shifted to the nucleus, which I had difficulty in observing; I was aware of strain in my eyes and brow, and of a forward movement of my body. A visual image of a nucleus appeared; the image and the percept corresponded, my attention being primarily upon the nucleus. I was aware of unpleasantness, and finally of vocal-motor imagery of 'very ugly.'"

Zalof, Card 6 (January 13, 1913) "No." Time, 1.6 sec. Introspection: "My attention went first to the general shape, and I was aware of a vocal-motor image of 'no.' Immediately this was inhibited, the inhibition consisting in the appearance of a vocal-motor image 'see nucleus.' Then I observed the nucleus, and was aware of vocal-motor images of 'blue' and 'long-shaped.' My negative reaction followed."

Zalof, Card 14 (January 13, 1913) "Yes." Introspection: "First of all my attention went to the nucleus. I found that the three apple-seed-shaped bodies were not separated and I hesitated upon this feature. Then came a vocal-motor image 'look at rest,' and I was aware of an attitude of desiring to exclude the figure on the basis of other characteristics, but of being reluctant to exclude it upon the basis of the nucleus alone. My attention went to the other features, and presently I was aware of a verbal image, vocal-motor, of 'rest right.'

My fixation returned to the nucleus, and the verbal imagery appeared 'can not throw it out on that.' My affirmative reaction followed." (Describe your attitude.) "I was aware of uncertainty about the nucleus; I could not clearly distinguish its parts. My attention then went to other parts of the figure."

Zalof, Card 17 (January 25, 1913) "Yes." Time, 2.6 sec. Introspection: "My attention went first to the pseudopodia. I was aware of a vocal-motor image 'arms right; are branched.' My attention then shifted to the nucleus. Then came a vocal-motor image of 'right shape; not red,' followed by 'doesn't need to be.' Then came my affirmative reaction."

Zalof, Card 13 (January 27, 1913) "No." Time, 2 sec. Introspection: "At the outset my attention happened to fall upon the nucleus, and I was aware of a vocal-motor image of 'no nucleus.' My reaction 'no' followed before I noticed the extremities at all."

Deral, Card 3 (December 9, 1912) "No." Time, 1.75 sec. Introspection: "My attention went to the central part of the uncolored side. The vocal-motor verbal image 'no point' occurred; then came the vocal-motor image 'one orange.' A visual image of a correctly pointed central line occurred. I observed that the central line between the two halves of the percept bulged toward the left. Toward the close of my observation I was aware of strain in my forehead, and of mild unpleasantness. My reaction followed. Vocal-motor imagery of 'ugly' occurred."

Deral, Card 5 (December 16, 1912) "Yes." Time, 5.6 sec. "I was aware of a series of rapid changes of fixation, or at least of attention, and as my regard fell upon a part of the figure I named it in vocal-motor images. The vocal-motor images were as follows: 'point,' blue,' 'square edged,' 'pseudopodia.' Then came a vocal-motor 'yes' which was not inhibited." (Were you aware of any 'yes' attitude before your inhibited 'yes?') "Yes. After my verbal image of 'blue' I was aware of a vocal-motor image of 'yes' which persisted."

Deral, Card 7 (December 16, 1912) "Yes." Time, 2.75 sec. Introspection: "I had great difficulty in observing the figure, because it was so small. I was aware of straining forward. My attention shifted without shifts of fixation; as it fell upon certain parts of the figure, vocal-motor images appeared. They were as follows: 'right pointed;' 'left notch, colored;' 'straight edge;' 'pseudopodia off.' Somewhere during this process the vocal-motor image 'yes' occurred which was inhibited by my attraction of attention to other features. I was also aware of vocal-motor imagery 'very small,' and then of 'size does not matter.'"

Deral, Card 9 (January 11, 1913) "Yes." Time, 12.25 sec. Introspection: "At the very first, I was aware of a vocal-motor image of 'yes,' which was inhibited by my effort to find a well-defined straight line in the lower left periphery of the figure. This line was straight, but it did not break off sharply, as it should. The rest of my observation consisted in a series of vocal-motor images, representing an argument as to whether I could decide that the lower line was straight enough to call the figure a Deral. I also verified my other elements, in shifts of attention and corresponding vocal-motor verbal images. The following were the images: 'left colored, right not;' 'pseudopodia;' 'point;' 'notch.' My attention then returned to the lower left." (Describe your vocal-motor verbal argu-

ment.) "I can remember the following verbal images: 'isn't square;' 'is square;' 'doesn't end sharply; is ending sharply necessary? Always was in others; was not in my definition; so we will call it Deral.'"

Deral, Card 2 (January 18, 1913) "Yes." Time, 3.2 sec. Introspection: "My attention went first to the left-hand figure, and the vocal-motor image of 'some brilliant red' appeared. I looked at that red for a while, simply as red. Then my attention shifted, and as it fell upon various parts of the figure, vocal-motor images representing those parts occurred, as follows: 'lower line;' 'notch;' 'striations.' Then my affirmative reaction followed."

Deral, Card 4a (January 18, 1913) "Yes." 11.2 sec. Introspection: "First of all my attention went to the form of the figure and a vocal-motor image of 'turned aside' appeared. I then verified all of my essential features in terms of shifts of attention and corresponding vocal-motor images as follows: 'color;' 'straight edge;' 'notch;' 'striations.' Then for a time I considered as to whether the statements of my definition, that the right-hand side was uncolored and the left-hand side was colored, could be changed so as to admit of an upper side being colored and a lower side being uncolored. This consideration was vocal-motor verbal, essentially, but I can not now remember all of the imagery. Throughout it my attitude was to include rather than to exclude. The verbal images which I can remember were 'definition right-left, this upper-lower.' 'Possible to consider merely laid on side.' 'Lower is to right, so can call it Deral.'" (How did that attitude appear?) "It appeared in an effort to find reasons for including the figure, rather than for excluding it."

Deral, Card 17 (January 27, 1913) "Yes." Time, 6.8 sec. Introspection: "My attention passed over the figure, and the points upon which I fixated were characterized in vocal-motor images as follows: 'straight edge;' 'colored;' 'curve;' 'notch.' Then my attention went to the median line, and the vocal-motor imagery of 'but has a notch, point isn't sharp but is there.' I was aware of strain and tension in my brows and eyes. Finally my affirmative response followed."

Deral, Card 18 (January 27, 1913) "Yes." (Frowns strongly.) Time, 4 sec. Introspection: "My attention went immediately to the color of the left-hand body. A vocal-motor image of 'good Lord!' appeared as I observed this. My attention then went to other features, and as my fixation fell upon them verbal images occurred, as follows: 'straight edge;' 'curved;' 'notch and point;' 'detached bodies;' 'pseudopodia;' 'shape right.' My attention then returned to the color, and I was aware of a vocal-motor consideration as to whether I could include the figure in spite of its color. I can remember the following imagery: 'definition says, left colored, color may vary.' 'According to the definition it is a Deral.' 'Should like to change definition to read 'left colored but color same for a given individual.' I was aware of extreme unpleasantness. Finally my affirmative response followed." (How completely was your vocal-motor consideration of the color present?) "It was rather complete. I can not give it exactly."

Tefoq, Card 1 (February 3, 1913) "Yes." Time, 12 sec. (Observer frowns markedly after 9 sec.) Introspection: "I was aware of shifting of attention to various parts of the figure, and of verbal images corresponding to the parts upon which my attention fell. The following were the verbal images; 'central body right;' 'green;' 'crow's

foot;' 'violet bodies.' With the last I was aware of hesitation; verbal imagery of 'don't know whether' appeared, and I was aware of wondering whether the presence of these violet bodies would make it necessary to exclude the figure. My attention then went to the periphery, and the following verbal images occurred (vocal-motor): 'circular;' 'cut, but small.' Then my attention went back to the violet bodies, and I was aware of more hesitation, of tension in my brows and of a straining toward the stimulus. Vocal-motor imagery of 'outer may be colored.' My affirmative reaction followed. Throughout my observation of this card, I was aware of an attitude of including the figure, if possible. My problem seemed to be, 'let's see if we can call this a Tefoq.'"

Tefoq, Card 5 (February 3, 1913) "Yes." Time, 8.2 sec. Introspection: "My attention shifted to various parts of the figure, and the points upon which it fell were characterized in verbal images, as follows: "picture frame;' 'central body right.' My attention then went to the periphery. 'Too circular;' 'cut.' My attention then shifted to the triangular patch, and a vocal-motor image of 'small body' appeared. I hesitated upon the central part in the small body and finally appeared a verbal image of 'that's right,' followed by a return of my attention to the periphery and the background. The following vocal-motor images occurred: 'uncolored;' 'color may vary;' 'no pseudopodia,—not always pseudopodia; 'too circular.' Finally, 'nothing in definition against this.' Then my affirmative response followed. I did not look for the crow's-foot."

Tefoq, Card 3 (February 8, 1913) "No." Time, 2.8 sec. Introspection: "My attention went to the outer edge, and never left it. The following vocal-motor images occurred: 'not circular;' 'general form circular;' 'pseudopodia; too confounded irregular.' Immediately my negative reaction followed. The experience was unpleasant in a mild degree."

Tefoq, Card 7 (February 19, 1913) "No." Time, 2.2 sec. Introspection: "My attention fell first upon the central body. The vocal-motor imagery of 'edges curved, should be sharp' appeared. My negative response followed, and I did not perceive the rest of the figure at all."

Tefoq, Card 10 (February 19, 1913) "Yes." Time, 8 sec. Introspection: "My attention fell upon the central projection and vocal-motor imagery of 'Gosh that's ugly!' occurred. I was aware of contraction of my brows and of unpleasantness. Then came vocal-motor imagery of 'let's do it systematically.' My attention went then in turn to all of my essential features, and as my fixation fell upon each point vocal-motor images appeared, as follows: 'sides green;' 'right shape;' 'top uncolored;' 'crow's-foot;' 'small triangle;' 'proper place.' My fixation then went to the circular body, and verbal imagery occurred as follows: 'shape right;' 'notch.' Then came verbal imagery of 'perspective awful;' 'no reason why it could not be.' Then came verbal imagery of 'got to say yes.' My affirmative response followed. I was aware of unpleasantness and frowning. My attitude throughout was that I would like to reject that figure but could not find any valid reason for doing so."

Tefoq, Card 12 (February 19, 1913) "Yes." Time, 6 sec. Introspection: "Noted successively different parts of the figure which were represented in vocal-motor imagery at the time, as follows: 'crow's foot;' 'shape;' 'green;' 'circular;' 'notch.' My affirmative response

followed. Immediately afterwards I was aware of a visual image of the figure, and I am quite sure that the small blue triangle was missing. Before the exposure terminated I did not look for it or notice it." (What was the immediate antecedent of the appearing of your visual image? "I do not know. It just came in while I was thinking about the shape of the figure, before introspecting."

Kareg, Card 4 (March 5, 1913) "No." Time, 4.6 sec. Introspection: "This was an exceedingly unpleasant experience. My fixation went first to the left-hand body; it remained there, and the rest of the figure was not perceived. I was then aware of a highly increased mental activity, in which I considered in vocal-motor verbal fashion, whether the two-sided pyramid was possible for a Kareg figure. Although there was nothing in my definition against it, I insisted that the pyramidal Kareg figures had had either five or three sides and never two sides. I can remember the following vocal-motor image: 'can not throw it out, but none like it.' On the basis of this awareness that none of the figures were like the present one, I rejected it. Throughout my observation, I had an attitude of wanting to throw out the figure, if possible. This was largely emotional."

B. The Main Process of Classifying. 1. *Nature of the Process.* In every case, the observers' classifyings were constituted by a peculiar and more or less persistent course or direction of consciousness, which consisted in the fact that attention passed successively to those regions of the classification-figure whose counterparts in the generalization-series had contained essential features. If the feature were definitely present (objectively) in the classification-figure, it stood out briefly and easily in the observer's attention; and the course of consciousness continued without interruption. In many instances, the conspicuous and first-established general features (when definitely present) were noted in exceedingly brief fashion, usually without a high degree of attention; the observers were then vaguely aware of the general shape of the figure. The finer and less gross features, when obviously present, usually stood out in somewhat greater clearness; this would follow, of course, from the mere fact that the observer was obliged to spend slightly more time in his examination in order to make sure of their presence.

This course of attention persisted either until the regions of all the essential features had been examined, or until an essential feature failed to stand out rapidly and clearly as the regard passed to its region, or until a striking non-essential feature attracted the attention. In either of the two latter cases, the region in question became unusually focal. If an essential feature were obviously absent, the course of the attention was usually terminated abruptly; sometimes, however, it resumed its course after the interruption.[6] If the essential feature were neither definitely present nor definitely

[6] *Cf.* Cautious classifications, p. 93.

absent, the attention was arrested for a longer or shorter time upon the region; and strains, tensions, and unpleasantness often made their appearance. After a time, the normal course of consciousness was resumed, usually in a less rapid and facile manner—*i. e.*, the observers proceeded cautiously.

In the great majority of cases, the observers' attention went first to those regions of the grosser general features which had first been established as essential. Yet the observers never reported that they searched for these regions; instead, the features themselves, if present, flashed out in consciousness at the first glance, whereupon the observation continued. With the Zalof cards, for example, the observers usually attended first to such conspicuous features as the mere triangularity, or the general outline, or the form of the central parts; and later they explored the tentacle terminations, or other finer details. When a conspicuous essential feature was present in altered form, the observers found that their regard was fastened at the outset upon its region. If an inconspicuous general feature were altered, the observers usually did not become aware of the fact until attention, in its ordinary course, reached the altered region.

Thus the main process of classifying—the observers' manner of perceiving the classification-figures—was characterized for consciousness by a passing of attention in more or less rapid succession to the regions of the essential features, *i. e.*, by a successive definitizing and focalizing in consciousness of these regions. This may be regarded as an attention-activity of questioning,—'Does it have the general features?'; and the ready standing-out of the feature itself, or its failure to stand out, when attention passed to its region, constituted respectively the affirmative and negative answers to the question. When an essential feature neither stood out in ready fashion nor failed definitely to appear, the observers gave their answers in a hesitant fashion.

2. *Component and Concomitant Processes of the Main Process of Classifying. a. Perception of the figure:* In many cases the process of classifying operated solely upon the visual structural basis furnished by the perception of the exposed figures.[7] *b. Additional contents:* Very frequently,

[7] *Cf.* especially *A; affirmative,* Zalof, Cards 7 and 10, p. 62, p. 63; Kareg, Card 1, p. 65; *negative,* Zalof, Card 3, p. 62; Tefoq, Card 4, p. 64; Card 11, p. 64; Kareg, Card 8, p. 65; *hesitant,* Zalof, Card 11, p. 63. *B: affirmative,* Zalof, Card 17, pp. 68f, first part; *negative,* Zalof, Card 9, p. 66; Card 12, p. 67; *hesitant,* Tefoq, Card 11, p. 70. *C: affirmative,* Cards 8 and 5, p. 73; *negative,* Zalof, Cards 9 and 13, p. 73. *D: affirmative,* Zalof, Card 10, p. 76; Deral, Card 12, p. 78; *negative,* Zalof, Card 8, p. 77; Deral, Card 8, p. 78; *hesitant,* Zalof, Card 2, p. 76; Deral, Card 18, p. 78.

however, the classifying was not so simple as this mere play of attention upon the classification-figure itself. In such cases, the observers reported the presence of other components besides their visual perceptions of the exposed figure. These additional components were of two sorts: *α*. Imaginal or sensory contents which reinforced the observers' findings during their examinations of the stimulus-figures themselves; and *β*. Imagery of the original series.

α. The contents which reinforced the observers' findings were usually verbal, but often non-verbal kinaesthetic. When verbal, they were usually identical with verbal images which had previously occurred during the first and later examinations of the generalization-figures. These images emerged as the observer's glance fell upon the corresponding region of the figure; and they appeared spontaneously and rapidly, usually with no specific recognition or conscious reference to the original series. Apparently they referred only to the present figure, whose examination they reinforced. The verbal imagery varied, according to whether the essential feature was present or absent in the region observed. When this feature was definitely present, the verbal imagery usually consisted merely in the verbal characterization itself.[8] Sometimes, however, the imagery included words which expressed the correctness of the feature, as it stood out (*E*, Zalof, Card 17, p. 81). Again, the verbal reinforcing imagery occurred in a slightly changed form, as if it were an answer to a question: it stated that a figure possessed a specified essential feature (*B*, Tefoq, Card 4, 'steps washed in green,' 'triangle blue,' pp. 69f). When, on the other hand, an essential feature was dissimilar or definitely absent, the verbal reinforcing imagery included words which expressed the absence or dissimilarity of the feature.[9] Or the verbal images were not identical with previously-employed designations, but instead they consisted in words which specified the nature of an altered region in the stimulus itself.[10]

The non-verbal kinaesthetic reinforcing contents consisted sometimes in imagery of the eye-movements of examining the figure,[11] and sometimes in internal imitations of the figure (*cf.* p. 103) which were often marked by discomfort and unpleasantness.[12]

β. The imagery of the original series was usually concrete visual, but sometimes verbal. When visual, this imagery made its appearance sooner or later after the exposure of the stimulus; the observer compared it with the stimulus figure, attending alternately to corresponding regions of percept and image. Thus the main classifying-

[8] *B*, Tefoq, Card 3, p. 69; Card 4, pp. 69f. *E*, Zalof, Card 2, p. 79; Deral, Card 5, p. 81; Tefoq, Card 12, pp. 83f.

[9] *B*, Deral, Card 1, 'not colored,' pp. 70f. *E*, Zalof, Card 4, 'no red nucleus,' p. 79; Card 13, 'no nucleus,' p. 81; Deral, Card 3, 'no point,' p. 81.

[10] *B*, Zalof, Card 6, 'has rounded corners,' p. 66; Deral, Card 1, 'black,' p. 71. *E*, Zalof, Card 4, 'four limbs,' p. 79; Card 6, 'blue,' 'long-shaped,' p. 80; Tefoq, Card 7, p. 83. *C*, Zalof, Card 6, p. 72.

[11] *B*, Zalof, Card 1, pp. 65f; Card 4, p. 66. *C*, Zalof, Card 11, p. 73; Deral, Cards 1 and 5, pp. 74, 75.

[12] *C*, Deral, Card 8, p. 74; Zalof, Card 2, p. 72; Card 4, p. 72; Kareg, Card 2, p. 73.

process ran its course in terms both of percept and image. The imagery was often relatively complete, sometimes presenting those members of the original series which resembled the stimulus, and sometimes presenting the extremes, in size and form, of the original (generalization) series. Again, the concrete visual imagery was fragmentary, presenting that part of the original figures which was dissimilar or absent in the stimulus.[13]

The occurrence of concrete imagery of the original groups during the observers' examinations of the classification cards may be correlated with two conditions: *a.* The number of times the observers had examined the generalization-groups, or the number of their classifications upon past occasions; and *b.* the nature of the classification-judgment,—whether facile (affirmative or negative) or hesitant. No observer ever reported the invariable presence of imagery of the original groups with any one type of judgment; and the relative number of the judgments of any one of the three varieties which actually involved such imagery varied widely with the different observers. For a more complete treatment of this subject, *cf. Individual Differences,* pp. 106 ff.

The verbal imagery of the original series sometimes accompanied the concrete visual. It invariably consisted in words characterizing an essential feature which was lacking in the stimulus.[14]

3. *The Initiation of the Main Process of Classifying.* The classifying-process was usually anteceded only by the hearing of the experimenter's question: 'Is this a Zalof (or Deral, etc.)?' and by the immediate appearance to consciousness of the figure for classification. No observer ever reported a definite *Aufgabe*-consciousness of accepting the task, or of setting up a goal-idea, or of self-instruction to adopt a certain procedure, or of explicit questioning—'will it have the Zalof (or Deral, etc.) essentials?' Instead, the questioning response of attention which was characteristic of the classifying-process followed immediately upon the perception that the stimulus was exposed.

Under certain conditions, however,—when the attention was arrested by a striking variable or by a markedly dissimilar essential, or when a premature tendency to respond had occurred,—the observers occasionally reported the presence of concrete or verbal imagery which was followed by a turning of attention to a new region, *i. e.*, which initiated the reinstatement of the main classifying-process. This imagery usually presented a part of the figure which had not yet been investigated. When this was the case, it was sometimes visual (*B*,

[13] *Cf. A: affirmative,* Deral, Card 4, p. 64; *hesitant,* Deral, Card 2, p. 64; Tefoq, Card 13, p. 65. *B: negative,* Zalof, Cards 6 and 17, pp. 66, 68; *hesitant,* Zalof, Card 10, p. 67; Card 2, p. 68; Tefoq, Card 1, with attention to background, p. 69; Card 10, p. 70. *C: affirmative,* Zalof, Card 7, p. 72; *negative,* Kareg, Card 8, p. 73. *D: affirmative,* Zalof, Cards 5 and 7, pp. 75, 76; *hesitant,* Zalof, Card 9, p. 76; Deral, Card 13, p. 78. *E: affirmative,* Zalof, Card 2, p. 79; *negative,* Deral, Card 3, p. 81; *hesitant,* Zalof, Card 8, p. 80; Card 10, p. 80.

[14] *B,* Zalof, Card 6, 'bifurcation,' p. 66; Tefoq, Card 5, 'hi-' (hieroglyphic), p. 69. *E,* Zalof, Card 4, 'three limbs,' p. 79.

Deral, Card 2, noting of right periphery, p. 71); more often, however, it was verbal,—either consisting of words which designated the essential feature subsequently investigated (*B*, Tefoq, Card 6, 'green wash,' p. 70), or taking the form of definite self-instruction to note the feature (*E*, Zalof, Card 6, 'see nucleus,' p. 80; Card 14, 'look at rest,' p. 80). When the imagery did not present a feature which was subsequently investigated it consisted in verbal self-instruction (*E*, Tefoq, Card 10, 'let's do it systematically,' p. 83) or in other kinaesthesis (*C*, Deral, Card 2, shock, p. 75). In the great majority of cases, however, no imaginal antecedents whatsoever marked the reinstallation of the classifying-process.[15] Here the series of examinings of the regions of essential features merely reasserted itself after a more or less prolonged period of interruption. In the light of these instances, it seems highly probable that when the re-initiation of the classifying-process was immediately preceded by concrete visual imagery this latter is to be interpreted as constituting the initial term of the process as reinstated, rather than as an *Aufgabe*-consciousness, an awareness of intending to continue the investigation. That is, the process re-commenced in concrete imaginal terms, instead of in perceptual terms.

It occasionally happened that an observer verbalized a classification-judgment before his survey of the figure was complete. Under these conditions he usually became aware, immediately afterwards, of the inadequacy of his observation, in terms of vague imagery of that part of the figure which had not been investigated; and a renewal of the process of classifying was initiated. When such images occurred before the figure was completely removed from view, they were followed by a rapid passing of the regard to that part of the figure which had previously escaped notice. If, however, the figure could no longer be seen, the imagery was followed by an effort to make a careful examination of the neglected region, in a visual image of the stimulus,—an effort which was not always successful.[16] At other times the imagery in question was accompanied by strain and affective content; and the whole functioned as a regret that the response had been given so soon (*C*, Zalof, Card 7, p. 73). Again, the imagery functioned—with or without the additional kinaesthetic and affective contents—as a desire to see the figure again, or merely as an awareness that certain parts of the figure had not been seen (*E*, Tefoq, Card 5, p. 83. *D*, Deral Card 12, p. 78). Even in such cases, however, it usually happened that the main process of classifying was rehabilitated spontaneously—operating in verbal or visual imaginal terms—with no antecedent contents whatever.[16] Here, too, then, it seems most probable that the antecedent imagery, where it occurred, is to be regarded as an initial term of the reinstated process of classifying, rather than as an *Aufgabe* or intention. Thus the only instances in which unequivocal contents of intending to investigate certain parts of the figure were present were the few cases, cited above, where observers reported verbal images of self-instruction, or contents which did not present parts later investigated. The continuous sequence of experiences which constituted the process of classifying followed immediately upon the awareness that the exposure had been

[15] *C*, Zalof, Card 7, p. 72; Deral, Card 12, p. 75. *A*, Zalof, Card 10, p. 63.

[16] *A*, Deral, Card 4, p. 64; *B*, Zalof, Card 1, p. 65; Card 10, p. 67; Card 12, p. 67; Card 17, p. 68; Tefoq, Card 4, p. 69. *C*, Deral, Card 2, p. 74. *D*, Deral, Card 11, p. 78.

made, after the hearing of the verbal instructions; it was never instigated by the occurrence of self-instruction of any sort, and only upon rare occasions did such instruction mediate its reinstatement after an interruption.

C. THE FINER COMPONENTS OF THE PROCESS OF CLASSIFYING: THE BEHAVIOR IN CONSCIOUSNESS OF THE FEATURES OF THE CLASSIFICATION-FIGURES. Thus far we have examined the process of classifying in its larger aspects,—its general nature, its structural aspects, its manner of initiation. We shall now consider its finer component processes. These latter consist in the behavior in consciousness of the specific regions over which or to which attention passed in its main course over the figure.

1. *Behavior in Consciousness of Obviously Present Essential Features: Facile Affirmation. a. Normal:* As has been pointed out, when asked to state whether a figure was a Zalof (or Deral, etc.), the observers adopted a mode of observation which in itself constituted a behavior of questioning 'does it possess the essential features?'; *i. e.*, the attention passed in more or less rapid succession to those regions of the figure which had been found to contain essentials. If a feature which the observer had found to be common was definitely present in the exposed figure, it flashed out into clear consciousness as the attention passed to and over its region; and this facile and often very brief standing-out of the feature constituted in itself the affirmative answer to the question which was constituted by the peculiar course of attention. Such a standing-out of an essential feature was sometimes accompanied by additional imagery (*cf.* pp. 86 ff.), and it was frequently followed by an affirmation of some sort (*cf.* p. 91). If the observation had not as yet been completed, the attention shifted easily and readily to other parts of the figure, without any delay upon the region in question; and if the observer did not note the absence of any essential feature, an affirmative response followed. The latter was sometimes verbalized before the course of attention reached its culmination.[17] (*Cf.* Premature Facile Affirmations, pp. 90 ff.).

[17] *Cf.* the following classifications: *With no structural content other than the percept itself, A,* Zalof, Cards 5, 7, and 10, pp. 62, 63; Kareg, Cards 1 and 5, p. 65; Deral, Card 5, p. 64. *B,* Zalof, Card 17, p. 68. *C,* Zalof, Cards 8 and 5, p. 73. *D,* Zalof, Card 10, p. 76; Deral, Card 12, p. 78. *With imagery of the original series (concrete visual), A,* Deral, Card 4, p. 64. *C,* Zalof, Card 7, p. 72. *D,* Zalof, Card 7, p. 76. *E,* Zalof, Card 2, p. 79.

When verbal imagery which reinforced or supplemented the observers' findings was present (*cf.* pp. 86 ff.) it took the form of

b. Premature Facile Affirmations: The reader will have noticed that observers frequently responded prematurely, before the attention had passed to the regions of all the essentials. In such cases, the affirmation which was aroused by the standing-out of the first essential or the first few essentials was followed by an affirmative spoken response before the course of the process of classifying was completed, or in other words, the affirmative reaction-tendency here overcame the main classifying-process. Affirmative classifyings of this sort are doubtless to be regarded as exaggerated forms of the classifyings in which a tendency to say 'yes' occurred before the close of the observation but was not actually followed by a spoken 'yes.' When the 'yes' was spoken in this premature fashion, however, the main process of classifying immediately reasserted itself, and it operated upon a basis of imagery of the stimulus, if the exposure had already terminated. That is, the attention passed to those parts of the image whose fellows in the percept had not been investigated. The observers were sometimes able to complete their classifyings in a glance at the disappearing stimulus, or else their imagery was definite with respect to the features which had not yet been investigated; when this was the case, they then proceeded to correct or to modify their premature response, or to indicate in some way that they were aware of the nature of the uninvestigated feature.[18] Sometimes, however, the observer's imagery was indefinite with respect to the uninvestigated parts; and he merely indicated in some way his awareness that his observation of the stimulus had been incomplete.[19]

naming the feature which stood out at the moment; and the naming was sometimes accompanied by words which expressed the correctness of the feature: *E*, Zalof, Card 17, p. 81. *Cf.* also the following affirmative classifications, in which the behavior in consciousness of the essential features was complicated by the presence of supplementary imagery: *Verbal, B*, Tefoq, Cards 3 and 4, pp. 69 ff. *E*, Zalof, Card 2, p. 79; Tefoq, Card 12, p. 83. *Kinaesthetic of eye-movement, B*, Zalof, Card 1, p. 66. *C*, Zalof, Card 11, p. 73; Deral, Cards 1 and 5, pp. 74, top; 75. *Kinaesthetic of internal imitation, C*, Deral, Card 8, p. 74; Zalof, Card 2, p. 72.

[18] *A*, Zalof, Card 5, p. 62; Deral, Card 4, p. 64; Kareg, Card 5, p. 65. *B*, Zalof, Card 1, p. 66; Card 17, pp. 68f; Tefoq, Card 4, p. 70. *C*, Deral, Card 2, p. 75; Card 8, p. 74; Card 12, p. 75. *D*, Zalof, Card 5, pp. 75f; Deral, Card 11, p. 78. *E*, Tefoq, Card 12, p. 84.

[19] *A*, Zalof, Card 10, p. 63. *C*, Zalof, Card 7, p. 72. Sometimes the observer mentioned that his observation had not been complete, without describing his awareness of this fact; it seems highly probable, however, that this awareness was not essentially different from that present and described on other occasions. *Cf. D*, Deral, Card 12, p. 78. *E*, Tefoq, Card 5, p. 83.

c. Cautious Affirmations: In many cases the observers reported that they had proceeded more cautiously, that the course of their attention was slower, and that the features stood out more clearly as they were successively noted. The more detailed and obscure features were here noted in a still more painstaking fashion. In the Zalof figures, for example, the observer examined the arrangement of the tentacle-ends of each of the three projections, instead of being satisfied with a single glance at one of them. As regards the conscious nature of the affirmative response itself, and the extent to which and the manner in which the behavior of the feature in consciousness was accompanied by other contents, the cautious affirmative reactions were similar to the other affirmative reactions. Indeed, the two sorts of classifications were often very difficult to distinguish; it was almost impossible at times to draw a line between the slower 'facile affirmations' and the more rapid 'cautious affirmations.' We have undertaken to make the distinction chiefly because it was found to constitute a useful basis for pointing out certain differences in observation-type among our observers (*cf.* pp. 105f, 108f, ff.).[20]

2. *The Affirmative Response:* The standing-out of the essential characteristics, constituting as it did the affirmative answer to the question present as the peculiar behavior of attention during the observation of the classification-figures, was in the great majority of instances followed only by a turning-away from the stimulus and a verbalizing of an affirmation; rarely, the latter was preceded by imagery of 'yes.'[21] The affirmative response was sometimes imaged in verbal terms after only one or more essential features had stood out, before the course of the observation was complete; it was inhibited by the continuation of the course of attention.[22] On rare occa-

[20] The following introspections illustrate the cautious type of facile affirmation; many of them have been referred to in previous paragraphs, but in later classifications they have been regarded as cautious: *A*, Deral, Card 5, p. 64. *B*, Deral, Card 1, as far as mention of negative tendency, pp. 70f. *D*, Zalof, Card 7, p. 76; Card 10, p. 76; Deral, Card 11, p. 78; Card 12, p. 78. *E*, Zalof, Card 2, p. 79; Card 7, pp. 79f; Card 17, p. 81; Deral, Card 5, p. 81; Card 7, p. 81; Tefoq, Card 5, p. 83.

[21] *A*, Zalof, Card 5, p. 62; Card 7, pp. 62f; Card 10, p. 63; Deral, Card 5, p. 64; Kareg, Card 1, p. 65; Card 5, p. 65. *B*, Zalof, Card 1, pp. 65f; Card 17, pp. 68f; Tefoq, Card 3, p. 69; Card 4, p. 69; Card 7, 'yes-tendency,' p. 70. *D*, Zalof, Card 10, p. 76. *C*, Zalof, Card 2, p. 72; Card 11, p. 73; Card 5, p. 73; Card 13, 'yes-tendency,' p. 73; Kareg, Card 2, 'yes-tendency,' p. 73; Deral, Card 8, p. 74; Card 5, p. 75; Card 12, p. 75. *E*, Zalof, Card 17, p. 81; Tefoq, Card 12, pp. 83f.

[22] *E*, Zalof, Card 2, p. 79; Card 7, p. 80; Card 8, p. 80; Deral, Card 5, p. 81; Card 7, p. 81; Card 9, p. 81. *Cf.* also 'yes-tendencies' cited in footnote 21.

sions observers reported that, as the process of classifying proceeded and as feature after feature stood out in the course of the attention, a gradual relaxing of the close concentration occurred, and the spoken 'yes' followed at the termination of the investigation (*B*, Zalof, Card 9, the 'yes-consciousness,' p. 66). Observers occasionally reported that the successive standing-out of the essential features was marked by growing pleasantness, or that pleasantness preceded the response or yes-imagery.[24] And kinaesthetic and organic contents, with or without pleasantness, sometimes entered into the affirmation-experience. At times these contents consisted in a kinaesthesis of tapping or waving the hand[25] or nodding.[26] Occasionally they consisted in vague organic and kinaesthetic sensations which the observers characterized in such terms as 'welling up' (*D*, Deral, Card 8, affirmative tendency, p. 78).

3. *The Behavior in Consciousness of Regions of the Figure where Essential Features had Formerly Occurred but were now Absent: Facile Negation. a. Normal:* When a figure of the classification-series lacked one of the essential features, or possessed it in a crucially dissimilar form, the attention was arrested at that region of the figure in which the feature should have been present. The altered region became unduly clear, and sometimes additional imaginal contents appeared. The arresting of the attention was sometimes not only described, but was also labelled by the observers as an awareness that the feature was different or 'wrong,' and sometimes it was labelled as an experience of unfamiliarity. At other times it was merely described, and not interpreted. In its present experimental setting it constituted a negative answer to the question (implicitly present as the characteristic behavior of attention) of 'does it have the essential features?' Such a halting of the attention was usually followed immediately by a negative response and by an abrupt termination of the attention-course. The observers often reacted to such an experience of 'something different,' without analyzing in detail the nature of the difference, or representing it to themselves.[27]

[24] *C*, Deral, Card 1, p. 74, top. *D*, Zalof, Card 5, p. 75; Card 7, p. 76; Deral, Card 11, p. 78; Card 12, p. 78. *B*, Zalof, Card 17, p. 68; Tefoq, Card 6, p. 70.

[25] *B*, Zalof, Card 2, p. 66. *C*, Deral, Card 1, p. 74 (near bottom).

[26] *C*, Zalof, Card 8, p. 73; Card 7, p. 72; Deral, Card 1, p. 74.

[27] *A*, Zalof, Card 3, p. 62; Tefoq, Cards 4 and 11, pp. 64f; Kareg, Card 8, p. 65. *B*, Zalof, Cards 3, 9, 12, 17, pp. 66f, 69. *D*, Zalof, Card 8, p. 77; Deral, Card 8, p. 78. *C*, Zalof, Cards 9 and 13, p. 73.

In relatively few cases observers reported that the arrest of the attention by the altered essential feature was marked by more or less intensive kinaestheses and organic sensations, one observer even mentioning a peculiar feeling of being suspended in the air. (*B*, Zalof, Card 13, p. 67; Tefoq, Card 7, attention to curves, p. 70.) The imagery of the original series, when it occurred, contained the altered or absent feature in prominent or even in isolated fashion. This was occasionally verbal imagery of the name of the feature in question;[28] often it was concrete visual, in which the feature was either dominant or present alone, *i. e.*, the imagery was fragmentary. In the latter case, the fragment of visual imagery was sometimes projected into its proper place in the stimulus-figure.[29] When reinforcing imagery occurred, if verbal, it either consisted in the designation of the absent feature preceded by 'no,' or else it characterized the nature of the change.[30] If the reinforcing imagery were kinaesthetic, of internal imitation, it was usually accompanied by discomfort or unpleasantness, such as would be experienced if the observer normally possessed the bodily attitude of the correct figure, but was now forced to take the distorted attitude of the stimulus.[31]

b. Cautious Facile Negation: In certain of their negative classifications, the observers proceeded in a relatively painstaking fashion; if the absence or crucially altered nature of an essential feature were noted before the course of the observation was completed, the observer inhibited his imagery of 'no' or his kinaesthesis of negation and continued his exploration of the figure.[32]

4. *The Negative Response.* The arresting of the course of the main process of classifying, constituting as it did the negative answer to the questioning course of attention—'does it have the essential features?'—was usually followed only by a turning of attention away from the stimulus with the voicing of a negative response.[33]

The actual negative response, however—the process of rejecting the figure—was sometimes more complex than this mere vocalizing of the 'no.' Observers sometimes reported that their spoken "no"

[28] *B*, Zalof, Card 6, 'bifurcation,' p. 66; Tefoq, Card 5, 'hi—,' p. 69. *E*, Zalof, Card 4, p. 79.

[29] *B*, Zalof, Cards 6 and 17, pp. 66, 68. *C*, Kareg, Card 8, p. 73.

[30] *B*, Zalof, Card 6, p. 66; Deral, Card 1, pp. 70f. *E*, Zalof, Cards 4 and 13, pp. 79, 81; Tefoq, Card 7, p. 83. *C*, Zalof, Card 4, p. 72.

[31] *C*, Zalof, Card 4, p. 72; Kareg, Card 2, p. 73. For kinaesthesis of eye-movement. *B*, Zalof, Card 4, p. 66.

[32] *A*, Zalof, Card 5, p. 63. *B*, Zalof, Cards 9, 15, and 18, pp. 67, 68, 69; Deral, Card 1, pp. 70f. *C*, Zalof, Card 3, p. 72. *D*, Deral, Card 4, p. 77. *E*, Zalof, Cards 3 and 6, pp. 79f; Deral, Card 3, p. 81.

[33] *A*, Zalof, Card 3, p. 62; Tefoq, Cards 4 and 11, pp. 64f; Kareg, Cards 4 and 8, p. 65. *B*, Zalof, Cards 3, 12, and 17, pp. 66 ff; Tefoq, Cards 4 and 5, p. 69. *C*, Zalof, Card 9, p. 73. *D*, Zalof, Card 8, p. 77; Deral, Card 8, p. 78. *E*, Zalof, Cards 4 and 6, pp. 79f.

was preceded by verbal imagery, sometimes of 'no'[34] and sometimes of words which expressed the reason for rejecting the figure.[35] In a few instances an observer mentioned a slowly-increasing vocal kinaesthesis of 'no,' which culminated in the spoken negation (*C*, Zalof, Card 4, p. 72). Again, the observers occasionally reported more emphatic rejections of the figure which were marked by the presence of varying amounts of kinaesthetic and affective content, and which were sometimes closely bound up with attitudes of 'belligerency' or of aesthetic disapproval of the figure.[36]

5. *Behavior in Consciousness of Indefinite Essentials: Hesitant or Uncertain Classifications.* Two sorts of hesitant or uncertain reactions occurred in our experiments: *a*. Those in which the observers hesitated upon a region in the stimulus-figure in which a certain essential feature was neither definitely present nor absent; and *b*. those in which the observers were uncertain as to the validity of their definition of the group, and were unable to remember whether a certain feature was or was not general. The former type of hesitant reaction was by far the more common. *a*. It occasionally happened that a feature which an observer had found to be essential was altered in a striking fashion, yet not so much so as to be definitely present or absent. When this was the case, the feature behaved in a characteristic fashion in consciousness; its mode of behavior was markedly different from the behavior of definitely present or absent essential features. All of the observers reported that when their regard passed to the altered region they attended more or less persistently to the altered parts. The region thus assumed an unusual degree of clearness. In many instances an altered non-essential feature or a striking variable one behaved in the same fashion.

The arrest of the attention and its subsequent compelling and prolonged holding by the altered essential or striking non-essential was usually followed by a reappearance of the main process of classifying, but in a modified form. The observers now finished their exploration in a highly deliberate and cautious fashion; they not infrequently interpreted this behavior as a desire to exclude the figure upon some basis other than that of the indefinite feature itself. Provided no other changed aspect claimed attention, however, the observer's regard usually returned to the indefinite region, and he

[34] *B*, Zalof, Card 9, pp. 66f. *C*, Zalof, Card 13, p. 73. *E*, Zalof, Card 3, p. 79.

[35] *B*, Zalof, Card 6, p. 66. *C*, Zalof, Card 6, p. 72. *E*, Tefoq, Card 7, p. 83.

[36] *B*, Zalof, Card 2, initial negative tendency, p. 68; Card 4, p. 66; Tefoq, Card 7, p. 70. *E*, Deral, Card 3, p. 81.

ultimately responded with an affirmative or a negative judgment, or in rare instances with a doubtful judgment. The response was affirmative in eighty-two per cent of our cases.

The arrest and prolonged holding of the attention by the altered region was usually marked, sooner or later in its course, by the presence of kinaesthetic and organic, or affective, contents, or all. The observers sometimes specified tensions, strains, frowning, and the like.[37] Sometimes the hesitation upon a feature was characterized by verbal imagery of questioning the nature of the indefinite aspect, or of fragments of the definition (*E*, Tefoq, Card 1, p. 82). Or this hesitation was occasionally marked by alternating affirmative and negative tendencies as the eye distinguished one aspect after another (*A*, Deral, Card 3, p. 63; *C*, Deral, Card 1, p. 74). In many instances imagery of the generalization-series, or imagery which supplemented the altered region in the stimulus itself, or both, occurred. The supplementary imagery was in all cases verbal. Sometimes it took the form of a more or less sketchily imaged argument, or of a silent vocalization of the aspects of the feature, as these stood out one after another;[38] again, it took the form of comments or judgments concerning the feature.[39] The imagery of the original series was visual, and the observer attended alternately to the region of the changed feature in the percept and the image.[40]

b. Occasionally an uncertain or hesitant reaction was marked by an observer's dissatisfaction with his definition, or by his inability to remember whether or not a feature had proved to be essential to the group. Dissatisfaction with the definition consisted in an attending away from the stimulus to imaged fragments of the definition—vocal-kinaesthetic or auditory verbal—accompanied by kinaesthetic and affective components, or by verbal images which expressed the nature of the inadequacy.[41] Inability to remember the exact nature of an essential feature, or to recall whether a feature had been found to be essential, consisted sometimes in the appearance of obscure consciousnesses of doubt and uncertainty, or of

[37] *A*, Deral, Card 2, p. 64; Tefoq, Card 13, attention to the central part, p. 65. *B*, Zalof, Cards 10, 2, and 5, pp. 67f; Tefoq, Card 1, attention to background, p. 69; Cards 10 and 11, pp. 70; Deral, Card 2, p. 71. *D*, Zalof, Cards 2 and 9, pp. 76f; Deral, Cards 1, 13, and 18, pp. 77, 78f; Kareg, Card 3, p. 79. *E*, Zalof, Cards 8. 10, and 14, pp. 80f; Deral, Cards 9, 4a, and 18, pp. 80f; Tefoq, Cards 1, 4, and 10, pp. 82 ff.

[38] *B*, Zalof, Card 5, 'bifur—,' p. 68; Deral, Card 2, p. 71. *D*, Deral, Card 1, attention to gray, p. 77. *E*, Deral, Cards 9, 4a, and 18, pp. 81f; Kareg, Card 4, p. 84; Tefoq, Card 10, p. 83.

[39] *E*, Zalof, Card 8, 'not similar,' p. 80; 14, p. 80; Tefoq, Card 1, 'violet bodies,' pp. 82f; 10, p. 83.

[40] *A*, Deral, Card 2, p. 64; Tefoq, Card 13, p. 65. *B*, Zalof, Cards 10 and 2, pp. 67f; Tefoq, Card 1, attention to background, p. 69; Card 10, p. 70. *D*, Zalof, Card 9, p. 76; Deral, Card 13, p. 78. *E*, Zalof, Cards 8 and 10, p. 80.

[41] *C*, Zalof, Card 1, p. 71. *E*, Deral, Card 4a, p. 82, Card 18, p. 82.

(in one case) non-bodily tensions, which were dominantly affective in character; the observer at the time attended to the doubtful feature, as it appeared in the stimulus (*D*, Zalof, Card 2, p. 76; Deral, Card 17, p. 78). At other times this inability consisted in attending away from the present stimulus to remembrances of the generalization-series, with kinaesthetic contents of questioning whether the feature were essential (*D*, Deral, Card 5, p. 77).

6. *The Behavior in Consciousness of Strikingly Dissimilar Non-general Features, or Conspicuous Novel Features.* It not infrequently happened that features which had been established as non-essential to the group attracted the observers' attention to a greater or less extent. Conspicuous novelties, or strikingly altered non-essential features received all degrees of attention. They were sometimes ignored; again, they stood out with all the clearness and persistence of altered essentials and were actually followed by a spoken negative response, although of course the alteration which claimed the attention did not afford logical justification for rejecting the figure. Many stages were represented between these two extremes, *a*. The variable feature was sometimes non-focally present to attention; here the observers noted its presence as an insignificant fact; it had no influence upon the course of the observation, nor did it arouse a reaction tendency.[42] *b*. Again, the attending to striking variables constituted a distraction from the course of observing the general features, which last was presently resumed. The variable was sometimes present in a high degree of clearness, and was even named, but had no effect upon the classification other than to delay its course.[43] *c*. Rarely, an observer reported that attention was withdrawn with difficulty from the compelling non-essential (*C*, Deral, Card 2, pp. 74f). *d*. Again, the standing-out of the non-general feature was followed by verbal imagery which expressed the non-essential character of the feature, or by verbal imagery of parts of the definition in which it had been stated that the group-figures proper might vary in respect to the feature.[44] *e*. In the majority of cases, however, the standing-out of the conspicuous non-essential feature was followed

[42] *B*, Zalof, Card 2, the bigness, p. 66; Tefoq, Card 3, the outline, p. 69. *D*, Zalof, Card 10, awareness of irregularity, p. 76; Card 2, awareness of redness, p. 76. At the time of *D*'s considerations of the 'hairs' and 'cilia' of the Deral figures he had not yet established these features as non-general in his examinations of the original series.

[43] *A*, Zalof, Card 11, p. 63. *C*, Zalof, Card 6, attending to 'dots,' p. 72. *E*, Deral, Card 2, 'redness,' p. 82.

[44] *E*, Zalof, Card 17, redness, p. 81; Deral, Card 7, size, p. 81.

by a more or less strong negative response which nevertheless did not actually overcome the course of the observation and thus lead to a spoken rejection. Any or all of the structural components which characterized the negative tendency or hesitant judgment (*Cf.* pp. 93 ff.) were sometimes present, and the whole experience was frequently followed by an unusually deliberate and thoroughgoing examination of the other regions of the figure, or by a strengthening of a negative response already present. Apparently more than the usual confirmation was necessary here in order to set free the affirmative response.[45] It frequently happened that imagery of a visual or verbal sort appeared, in terms of which the observers became aware of the possible variable character of the feature under observation. These two modalities of imagery obviously functioned in a strikingly similar fashion.[46] *f.* And the highest degree of attention to variable features is exemplified in those cases where the standing-out of the non-essential feature was followed by an actual negative response (*A*, Tefoq, Card 11, p. 64).

7. *The Experiences of Familiarity and of Unfamiliarity.* Some of the observers occasionally reported that they were aware that a feature was new or unfamiliar or that it was familiar. They sometimes spoke of a 'feeling of familiarity,' or merely of 'familiarity.' They were usually able to analyze these consciousnesses; and they found them to consist essentially in a peculiar form of behavior of the novel or the familiar feature in consciousness. The experience of unfamiliarity or of newness invariably consisted in the fact that the course of attention was arrested, or blocked, by a feature which was dissimilar to the form that it had been observed to possess in the original series; and the feature thus attained a relatively higher and more prolonged clearness.[47] Sometimes kinaesthetic components —respiratory, or manual, of pointing,—and affective components appeared in addition to the characteristic behavior of the features in consciousness.[48] The experience of familiarity proved, for *A* at least, to be more difficult of analysis. With *C*, this experience consisted essentially in the rapidity and readiness with which a feature stood out in her perception (Deral, Card 5, p. 75); sometimes marked kinaesthetic contents (respiratory changes and internal imitations) and pleasantness were present in addition (Deral, Card 1, p. 74, near bottom).[49]

[45] *B*, Tefoq, Card 6, bigness of outline and smallness of stairs, p. 70; Zalof, Card 5, p. 68; Deral, Card 2, redness, p. 71. *A*, Zalof, Card 5, p. 63; Deral, Card 2, p. 64; Tefoq, Card 1, p. 64.

[46] *B*, Tefoq, Card 1, p. 69; Card 10, p. 70. *E*, Tefoq, Card 1, p. 83; Card 5, p. 83; Card 10, p. 83.

[47] *A*, Kareg, Cards 1 and 4, p. 65.

[48] *C*, Zalof, Card 6, 'dots,' p. 72. *B*, Zalof, Card 2, 'strange new feeling,' p. 68.

[49] There seems little reason for doubting that in *A*'s case also the experience of familiarity consisted in the fact that the familiar feature stood out readily and rapidly, and did not interfere with the course

Hence it appears that the experiences of familiarity and of unfamiliarity consisted essentially in peculiar modes of behavior of certain features in consciousness, with or without additional kinaesthetic and affective components. In all cases in which the labels of 'familiarity' or 'novelty' were applied by the observers to such experiences, moreover, our introspections indicate the presence of contents and factors in virtue of which the experience was striking and focal, a condition which evidently favored its reflective interpretation or labelling. These contents included intensive kinaesthesis[50] and prolonged duration of the blocking of attention.[51] Moreover, the presence immediately before the experience of one of the opposite sort favored its being labelled.[52]

Nevertheless, many experiences whose conditions were similar to those just described were not interpreted as familiarity or unfamiliarity, but were instead merely described, or described and labeled as acceptance or rejection of the figure, as awareness that something was wrong, as belligerence or hostility toward the figure, etc.[53] In other words, the remarkable fact appears that exactly the same sort of experiences were sometimes labeled as familiarity or unfamiliarity, as acceptance or rejection, as a yes-tendency, as an awareness that something was wrong, or indeed were not labeled at all.

Our experimental data are not sufficiently numerous to indicate in any complete fashion the conditions under which these several labels were employed by the observers. But a reference to the experimental situation throws much light upon the matter. The observers were in an 'Is-it-a-Zalof?' situation; the attention-coursing which composed the process of classifying constituted in itself the question, 'Does it have the essentials?'; and the experiences of ease and readiness of observation, or of arrest of attention, normally shifted without more ado into a 'yes-ness' or 'no-ness,' *i. e.*, they *meant* an acceptance or rejection of the figure. Consequently the observers would ordinarily merely describe the experience, without labeling it, or if for any reason they did reflect upon it or label it in retrospect, the

of attention. In the few classifications in which he reported that a feature seemed familiar, his noting of this feature was characterized by ease of observation and by non-interference with the course of attention. The experience of familiarity was usually much less eventful and striking than that of unfamiliarity, a fact which readily explains the greater difficulty which *A* experienced in analyzing it *A* was more successful in analyzing his familiarity during his examinings of the figures of the group proper; and his analysis here supports our present contention: *Cf. op. cit.* p. 57, foot-notes 57, p. 94 and 63, p. 96.

[50] *B*, Zalof, Card 2, p. 68. *C*, Zalof, Card 6, p. 72; Deral, Card 1, p. 74, near bottom.

[51] *A*, Kareg, Cards 1 and 4, p. 65.

[52] *A*, Deral, Card 2, familiarity which occurred after the blocking of attention by the redness, p. 64. *C*, Deral, Card 1, recognition after the initial negative tendency, p. 74, near bottom; Card 5, *cf.* doubt in connection with the previous figure, p. 75. In one introspection, at least, there is evidence that the same holds for the experience of certainty: *Cf. B*, Zalof, Card 10, p. 67. This certainty followed upon a previous doubt.

[53] *A*, Tefoq, Card 13, p. 65. *B*, Zalof, Card 4, p. 66; Tefoq, Cards 1, 6, 7, and 11, pp. 69f. *C*, Zalof, Card 13, p. 73; Kareg, Card 2, p. 73.

label favored would be that of acceptance or rejection of the figure, or of a feeling that it did or did not belong to the group. The observers were not in a recognizing situation,—the problem was not 'have you seen this figure?'—and hence the label of 'familiarity' or 'novelty' was here more remote. Consequently it is not surprising that the observers relatively seldom mentioned familiarity or awareness of novelty. The situation, then, was undoubtedly the most important factor in the interpretation or labelling of the experiences of fluency, or of difficulty and arrest of attention. Nevertheless the fact that the observers sometimes employed labels that were less directly in accord with the favored one indicates that other factors co-operated. These probably included such factors as the striking character of the components, and individual interpretation-tendencies.

D. The Relation Between the Main Process and the Affirmative or Negative Response. The preceding sections have indicated that two distinct sorts of process were operative in our classification-experiments. One of these was the characteristic course of the classifying as a whole, *i. e.*, the well-marked and unmistakable passing of attention and regard in successive fashion to the regions of figures which had been found to contain essential features. The other process was the characteristic response to the behavior in consciousness of any one feature—the affirmative response to the rapid and easy flashing out of the feature, the negative response to the sharp halting and prolonged arresting of attention upon the feature. The former was more dynamic, more forward-pushing. The latter tended toward the static; it constituted in a sense a response of consciousness to the events which composed the former. When the response was not prevented from realizing itself by the immediate continuation of the process it became richer in imaginal or kinaesthetic content, and it merged into the complex 'attitudes' which were frequently labelled as acceptance or rejection of the figure, or even as familiarity or unfamiliarity, novelty.

Our experiments indicate that a peculiar balance, or interplay, existed between these two processes or directions of consciousness. Under the conditions of our experiments, the uninterrupted and easy continuance of the process at any point in its course was endowed with a strong affirmative response-tendency; at the outset, however, this fused with the main process, and retarded the latter only slightly, if at all, *i. e.*, the continuum of the examination of the figure was straightforward, practically no approximations toward the response-state occurring. Soon, however, the response began to realize itself in more energetic fashion, and at times actually consisted in a spoken judgment, with momentary banishing of the process of classifying. (*Cf.* premature affirmations.)

Nevertheless, the classifying-process, when thus interrupted, always became reinstated upon a later occasion.

The negative response which attached to the blocking or arrest of attention upon any feature, when not immediately verbalized, usually constituted the condition of a marked retarding and prolonging of the process of classifying, when the latter became reinstated. The negative response was not confined to those arrests of attention which occurred in the normal course of the classifying-process; it also attached to arrests which were occasioned by striking variables. In other words, the negative significance which theoretically should have attached only to arrests of the classifying-process, *i. e.*, to altered essential features, also attached in some degree to striking non-essential features as well. Moreover the negative response-tendency even under these conditions was followed by a slowing of the classifying-process, when the latter became reinstated. But the negative response-tendency, when it occurred under these conditions, seldom became verbalized; its occurrence outside of the normal attention-route apparently meant a diminution of its energy, or capacity for full realization. Thus the main classifying-process and the negative response, while to some extent independent, nevertheless possessed neural bases which exerted a profound influence upon one another.

E. Individual Differences. 1. *Structural.* The structural differences among our observers had to do with the nature of the imaginal and sensory and affective components which supplemented the observers' classifications of the stimulus-figures. These components embraced five types: *a.* Imagery which presented the figures of the group proper ('group-imagery'); *b.* Contents which reinforced the observers' perceptual findings; *c.* Contents which entered into experiences of doubt or of hesitation; *d.* Personal reactions to the figures; and *e.* Contents which accompanied experiences of affirmation or of negation.

a. Group-imagery: The imagery which presented the figures of the group proper was concrete and verbal. The observers differed both as to the relative dominance of the two sorts of imagery, and as to the nature of the concrete imagery itself.

A is the only observer whose group-imagery was exclusively of one type; in his case, such imagery was concrete visual in every instance. Usually it consisted of several images of members of the original series;[54] sometimes it consisted in a single such image (Zalof, Card 7, p. 62). And rarely, his group-imagery consisted of a single schematic visual image (Tefoq, Card 13, p. 65). When *A*'s group-imagery consisted of a single particular visual image, this presented

[54] *A*, Deral, Cards 2 and 4, p. 64; Tefoq, Card 1, p. 64.

a member which resembled the stimulus-figure—sometimes one which possessed certain variable features which were similar to the variables in the present figure.

B, *D*, and *E* reported that their imagery of the original group was visual or verbal, or both. *B*'s visual images were probably the most clear and distinct of those of any of our observers. They were sometimes definite and complete and particular, of certain members of the series;[55] at other times they were semi-particular.[56] These definite and complete particular or semi-particular images were usually similar to the stimulus in form and size and in the possession of certain individual variations; and it often happened that *B*'s hesitation over a feature was terminated by the appearance of an image of a member of the series which contained a similar feature. Sometimes, on the other hand, *B*'s visual group-images were fragmentary, of parts of figures. When she became aware that an essential feature was missing, she often projected a visual image of this feature into its proper place in the stimulus-card. The fragmentary visual images were particular in nature.[57] *B*'s verbal series-presentations occurred for the most part when she noted the absence of an essential feature, or a change in such a feature; and they were usually preceded by imagery of 'no.' The verbal images were for the most part auditory,[58] but sometimes they were also vocal-kinaesthetic, when they were frequently vague and fragmentary (Tefoq, Card 5, p. 69). Moreover, the verbal images often possessed definite inflections—questioning (Zalof, Card 17, p. 68) and the like. *B*'s verbal group-imagery functioned upon rare occasions as an intention to note certain features (Tefoq, Card 6, 'green wash,' p. 70).

D's imagery of the original group, when visual, represented varying degrees of clearness and completeness and distinctness; but it was definite in the possession of the features which he had discovered to be essential to the group, and particularly of the features to which he was at the time attending. In all but one instance *D*'s visual imagery presented particular figures—a single one, or a number of them; and the images either presented members of the original series whose form most closely approximated that of the stimulus (Zalof, Card 3, Card 5, p. 75) or else they included the extremes, in form and size, of the group (Zalof, Card 7, p. 76). *D*'s verbal imagery included words which characterized the essential features of the group, and which he had used, during his examinations of the members, to characterize features whose generality he was investigating (Deral, Card 1, p. 77). In some cases D reported verbal imagery which took the form of a question regarding the nature of the original group (Deral, Card 5, p. 77). Occasionally such a verbal image functioned as an intention to investigate a certain part of the figure.

E's concrete visual group-imagery was sometimes particular or semi-particular—of definite members of the group. When this was the case, the imaged figure was almost always one which approximated the stimulus in size and form (Zalof, Cards 3, 7, 10, pp. 79f). Again *E*'s visual images were fragmentary, of parts of

[55] Zalof, Card 10, p. 67; Card 2, p. 68; Tefoq, Card 1, p. 69; Deral, Card 1, p. 70.

[56] Zalof, Card 15, p. 68; Tefoq, Card 5, p. 69; Card 10, p. 70.

[57] Zalof, Card 18, p. 60; Card 13, p. 67; Tefoq, Card 5, p. 69.

[58] Zalof, Card 6, 'bifurcation,' p. 66; Card 15, 'bifurcations,' p. 68; Card 17, auditory imagery of definition, p. 69; Tefoq, Card 10, p. 70.

the original figures which corresponded to the regions now being investigated in the stimulus (Zalof, Card 2, p. 79; Card 8, p. 80). His visual imagery was inclined to be vague and rather indistinct in all but the grossest features. *E*'s verbal imagery was usually vocal-kinaesthetic, but sometimes auditory as well; and it was remarkable for its completeness and distinctness and frequency. It is difficult to distinguish his verbal group-imagery from his verbal imagery of supplementation of his findings. In some instances, however, the former appeared before he had noted whether the designated feature was present in the stimulus; and it then functioned as self-instruction to look for that feature (Zalof, Card 6, 'see nucleus,' p. 80). Again, they consisted in parts of the definition, usually expressing the variable character of a feature being observed in the stimulus (Zalof, Card 17, 'not red—doesn't need to be,' p. 81. Deral, Cards 4a and 18, p. 82).

C's presentations of the original group-members included the widest range of image-modalities which was exhibited by any of our observers. Her group imagery was concrete visual and kinaesthetic of internal imitation, as well as verbal. *C*'s concrete visual images varied in distinctness and completeness; they usually presented whole figures, and were sometimes particular or semi-particular,[59] and sometimes fragmentary (Zalof, Card 7, p. 73). At times *C*'s kinaesthetic and organic contents of internal imitation consisted in strains and tensions and organic sensations of being posed in an attitude similar to the main form of the group members; they consisted in revivals of similar contents which had been present during the observer's examination of these figures.[60] Her verbal imagery was visual (Zalof, Card 4, p. 72) or vocal-kinaesthetic.[61] It included parts of her definition, or words which referred to various features of the original group; or sometimes the words accompanied a visual image and expressed its generality, or typicality of the series (Kareg, Card 8, pp. 73f).

b. Contents which reinforced the observers' perceptual findings: All of the observers excepting *A* occasionally reported the presence of imagery which reinforced their findings in the stimulus which was being observed; and they differed both in the amount and in the nature of this imagery.

D's and *E*'s imagery of their findings was exclusively verbal. In *E*'s case this imagery included for the most part images of words which had been used during the examination of the group to designate features which were being investigated, and it now appeared as a confirmation of the presence of these same features in the classification-stimulus (Zalof, Card 2, p. 79, etc.). Very frequently, however, the words referred to variations which were peculiar to the present figure (Zalof, Card 4, p. 79; Deral, Card 3, p. 81, etc.). Again, *E*'s verbal images referred to the similarity or dissimilarity of the stimulus to the original figures (Zalof, Card 8, p. 80). *D*'s verbal imagery designated for the most part certain peculiarities of the perceived stimulus (Zalof, Card 5, p. 76.

B's reinforcing imagery was rather infrequent; it was usually verbal, auditory or vocal-motor (Zalof. Card 12, p. 67; Deral, Card 2, p. 71; etc.) and sometimes kinaesthetic, of eye-movement (Zalof. Card 1, p. 66). *C*'s imagery of her findings in the classification-

[59] Zalof, Card 7, p. 72; Deral, Card 1, p. 74 (near bottom); Kareg, Card 8, p. 73.

[60] Zalof, Card 1, p. 71; Card 2, p. 72; Card 4, p. 72.

[61] Zalof, Card 1, p. 71; Card 4, p. 72; Deral, Card 1, p. 74.

figures was widely varied in nature,—more so than that of any other observer. It was vocal-kinaesthetic or visual verbal, the words either representing features which were peculiar to the stimulus (Zalof, Cards 3, 6, p. 72) or else designating the resemblance or lack of resemblance of the stimulus to the group (Kareg, Card 2, p. 73). Occasionally *C*'s supplementary stimulus imagery (or sensory content) was kinaesthetic, of eye-movements (Zalof, Card 3, p. 72; Deral, Card 2, p. 75). But far most striking and characteristic were her kinaesthetic and organic contents of internal imitation of the stimulus; she felt herself as posed—extended or constricted—in an attitude which resembled the main lines and directions of the stimulus figure; and if these differed from those of the group figures, she usually reported an empathic element of the discomfort—lack of balance, or strain, or dizziness—which would ensue from being in a position similar to that of the stimulus. In other words, the imitated position of the original figures was apparently a relatively comfortable one, *i. e.*, no unpleasant strain or discomfort was reported. But the distorted positions of some of the classification-figures occasioned the same discomfort, with her imitation of them, which she might feel if forced to maintain such a distorted position; and this discomfort, or feeling of lack of balance, was endowed in the experimental situation with a strong negative significance. *Cf.* Zalof, Card 4, p. 72; Kareg, Card 2, p. 73; Deral, Card 1, p. 74 (near bottom); Card 2, p. 75.

c. Contents which entered into experience of doubt or of hesitation: The observers reported in varying degree the presence of experiences of doubt, or of hesitating on a feature. These experiences were exceedingly rare in the case of *C*, who was one of the most rapid classifiers, and who reported fewest cautious classifications (*cf.* p. 109); and with both *C* and *A*, experiences of doubt and hesitation were nothing more than the behavior in consciousness of the doubtful feature,—the manner in which it was present, and (with *A*) the cautious investigation which followed, and the tendency for the attention to return to the doubtful region. *B* reported more or less intensive kinaestheses in addition,—catchings of the breath (Zalof, Card 1, p. 66) and unpleasantness, with tensions about the chest, eyes, forehead, etc. (Tefoq, Card 11, p. 70). In the cases of *D* and *E*, the components which emerged in experiences of doubt or hesitation were kinaesthetic and organic and affective, or all three. *D* frequently reported *Bewusstseinslagen* of doubt and hesitation, which were essentially organic and kinaesthetic and unpleasant—largely the latter—and which were very difficult to localize (Zalof, Card 2, p. 76). Once he reported a 'non-bodily tension' which he was unable to describe more fully (Deral, Card 17, p. 78), and once he reported a 'mental paralysis'—a very intensive tension (Deral, Card 18, p. 79). *D*'s hesitation was sometimes dominantly verbal in content—vocal-kinaesthetic contents of questioning whether a certain feature was present. *E* usually reported that his doubt regarding a feature was characterized by kinaesthesis of close observation—strain about the eyes and brows—and by verbal imagery which expressed the nature of his difficulty: *Cf.* Deral, Card 9, p. 81; Card 4a, p. 82; Card 17, p. 82; Card 18, p. 82; Tefoq, Card 1, p. 83; Card 10, p. 83; Kareg, Card 4, p. 84.

d. Personal reactions to the figures: *B* and *E* occasionally reported certain experiences which may perhaps be called personal reactions toward a figure. In *E*'s case, these reactions were aesthetic; they consisted in the fact that a figure was pleasing or disagreeable to

him, or that it appeared ugly. The reactions were either entirely affective, or affective and kinaesthetic—strains in forehead, face, or chest—and verbal images—'ugly,' and the like: *Cf.* Zalof, Card 10, p. 80; Deral, Card 3, p. 81; Tefoq, Card 10, p. 83. In *B*'s case the personal reactions were closely bound up with her negative attention-behavior, and she sometimes characterized them as 'hostility' or 'belligerency' toward the stimulus-figure. These states were kinaesthetic and organic and usually affective; most frequently they were bound up with the reaction-word itself, and contributed to it a peculiar explosiveness of pronunciation, or emphatic intonation. *Cf.* Zalof, Card 4, p. 66; Card 9, p. 67; Card 13, p. 67; Card 15, disgust with bifurcations, p. 68. *B*'s personal reactions toward the figures appeared only in the Zalof classifications, which came first. This fact indicates the presence of a mechanizing process, by which the reactions became more and more confined to the fundamental play of attention.

e. Contents which accompanied the experiences of affirmation or negation. All of the observers reported more or less frequently that images of 'no' or of 'yes' accompanied their affirmative or negative attention-processes, or followed immediately upon them. All of the observers excepting *A*, however, reported at times the presence of additional contents, which latter differed with different individuals. *E* occasionally reported that the negative attention-response was followed by images of words which expressed the impossibility of the questionable feature being present in the original group, or which designated the respects in which the feature was dissimilar (Tefoq, Card 3, Card 7, p. 83). *C*, *B*, and *D* frequently reported organic and affective components, and *C* reported on rare occasions the presence of verbal images which expressed the reason for her rejecting the figure. Her affirmative contents usually consisted in kinaesthesis of nodding (Zalof, Cards 7 and 8, pp. 72f) and sometimes in a wave of the hand as well (Deral, Card 1, p. 74, near bottom). The additional components in her experiences of negation appeared as vocal-motor kinaestheses which preceded the spoken 'no' (Zalof, Card 4, p. 72) or as kinaestheses of squinting or wrinkling the forehead (Zalof, Card 1, pp. 71f). *B* frequently reported that her affirmation-experience was complicated by kinaesthesis of relaxing (Zalof, Card 2, p. 68) or by pleasantness (Zalof, Card 17, p. 68). Her experience of negation was sometimes marked merely by kinaesthesis of turning away from the stimulus (Zalof, Card 9, p. 67) and sometimes by kinaesthesis of shallower breathing and intensive fixating upon the feature (Zalof, Card 2, p. 68), or of bodily rigidity (Tefoq, Card 6, p. 70). *D* frequently reported that pleasantness accompanied his experience of affirmation: Zalof, Card 5, p. 75; Card 7. p. 76; Deral, Cards 11 and 12, p. 78. In one instance he reported an organic 'welling-up' with a kinaesthesis of extending his hand (Deral, Card 8, p. 78); again, he mentioned a 'willingness to accept' a feature, which willingness was composed in part at least of affective toning. His experiences of rejection were sometimes complicated by the presence of emotional components (Deral, Card 1, p. 77) or by slight shock (Deral, Card 4, p. 77).

2. *Functional:* The functional differences among our observers had to do with *a.* the extent to which the process of classifying was supplemented by imagery of the original series; *b.* the contditions under which such imagery appeared;

c. the extent to which the classifying-process was diverted from its course by striking irrelevancies; and *d.* the relative dominance of the main process of classifying, on the one hand, and of the affirmative or negative reaction-tendencies, on the other hand.

a. The extent to which the process of classifying was supplemented by imagery of the original series: Table II indicates the extent to which imagery of the original series occurred in the classifyings of every observer (*cf.* the two

TABLE II

The total number of classifications of every type for each observer with the per cent of cases in which imagery of the original series occurred in each type of classification. The main column-headings represent the types of classifications: facile affirmative and facile negative, cautious affirmative and cautious negative, and hesitant. Of the two columns under each main caption, the left contains the total number of classifications of that type, and the right contains the per cent of that number in which imagery of the original series appeared.

	Facile				*Cautious*				*Hesitant*		*Total*	
	affirmative		*negative*		*affirmative*		*negative*					
Obs.	No.	% Im.	No.	% Im.	No.	% Im.	No.	% Im.	No.	% Im.	No.	% Im.
A	8	00	4	00	1	00	2	00	2	50	17	6
B	8	12	8	50	1	00	5	80	6	33	28	29
C	6	16	7	28	0	00	1	00	1	100	15	27
D	3	66	3	33	3	00	5	40	3	33	17	35
E	2	100	6	16	3	66	4	50	9	33	24	41
Total	27	22	28	28	8	25	17	47	21	38	101	32
A	3	66	1	00	1	00	2	00	3	100	10	50
B	0	00	0	00	0	00	1	100	1	100	2	100
C	4	25	3	33	0	00	0	00	3	33	10	30
D	0	00	5	00	3	00	2	00	8	12	18	5
E	7	00	8	12	2	00	0	00	6	00	23	4
Total	14	21	17	11	6	00	5	20	21	28	63	16
A	3	00	4	00	4	00	1	00	3	100	15	20
B	3	33	5	40	0	00	1	100	4	50	13	46
E	5	20	4	00	1	100	0	00	3	33	13	23
Total	11	20	13	15	5	20	2	50	10	60	41	29
A	6	40	3	33	0	00	0	00	0	00	9	33
C	1	00	0	00	0	00	2	50	0	00	3	33
D	0	00	2	00	2	00	1	00	2	00	7	00
E	4	00	2	00	0	00	0	00	2	50	8	12
Total	11	20	7	14	2	00	3	33	4	25	27	18
A	20	20	12	8	6	00	5	00	8	88	51	23
B	11	20	13	45	1	00	7	85	11	45	43	44
C	11	20	10	30	0	00	3	33	4	50	28	29
D	3	66	10	10	8	00	8	25	13	15	42	16
E	18	16	20	10	6	50	2	50	20	25	68	22
Total	63	20	65	20	21	14	27	40	56	37	232	26

columns on the right). From these columns, it appears that the Zalof classifications (which were first chronologically) and the Tefoq classifications (which figures were most complex) were more extensively characterized by imagery of the original series than were the Deral and Kareg figures. Apart from this fact, however, the observers showed marked differences in the amount of such imagery in their classifications both of the same and of different groups. In the Zalof series *D* and *E* reported relatively more series-imagery than any of the other observers; in the cases of both these observers the appearance of imagery was correlated with the number of classifications which had been made (*cf.* following paragraph). In the later series—the Deral, Tefoq, and Kareg groups,—as well as in the combined classifications of all groups—*D* and *E* reported a smaller amount of series imagery than did any of the other observers. Of these two, *E* reported more imagery than *D*, *B* and *C* reported the most profuse imagery of the group, for the most part. *A* reported less than *B* and *C*, on the one hand, and more than *D* and *E* on the other.

b. The conditions under which imagery of the group occurred: Table II indicates the per cent of the classifications of each type which were complicated by the presence of group-imagery. Table III indicates the relation between the occurrence of group-imagery and the number of classifications which the observers had made. The total number of classifications was arranged in groups of five successive classifications (the last group numbering less than five, provided five was not a multiple of the total number) and Table III contains the number of classifications of each group in which series-imagery figured.

TABLE III

Relation between the occurrence of group-imagery and the number of classifications. The Roman numerals refer to groups of five successive classifications each; the figures in the other columns indicate the number of classifications in the group which were characterized by the presence of imagery of the original series. Thus, Observer *A* reported no such imagery in his first five classifications, none in his second five, one in his third five, etc. A dash indicates that the classifications were not sufficiently numerous to include a group of the advancement specified.

	Zalof					*Deral*			*Tefoq*			*Kareg*			
	A	*B*	*C*	*D*	*E*	*A*	*D*	*E*	*A*	*B*	*E*	*A*	*C*	*D*	*E*
I.....	0	1	3	4	5	4	1	1	1	2	2	1	3	0	1
II.....	0	1	1	2	4	1	0	0	1	2	1	2	3	0	0
III.....	1	2	—	0	1	—	1	0	1	2	0	—	—	—	—
IV.....	—	4	—	0	—	—	0	0	—	—	—	—	—	—	—
V.....	—	1	—	—	—	—	—	0	—	—	—	—	—	—	—
VI.....	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—

TABLE IV

This table shows the per cent of classifications in which attention was distracted in varying degree by striking non-essentials, with or without an ensuing negative response. The first column of figures contains the total number of classifications, of the series specified, furnished by each observer. The next four columns contain the per cent of instances in which occurred *1*. distraction with a negative response; *2*. distraction with no negative tendency; *3*. distraction with or without negative tendency; and *4*, non-focal-awareness of the variable feature.

	Observer	*Total number classifications*	*Per cent distraction with negative response*	*Per cent distraction with no negative tendency*	*Per cent distraction with or without negative tendency*	*Per cent non-focal awareness of variable features*
Zalof	*A*	17	6	12	18	0
	B	28	7	0	14	3.5
	C	15	0	7	7	0
	D	17	0	0	0	29
	E	24	4	0	4	0
	Total	101	4	5	9	6
Deral	*A*	10	10	10	20	0
	B	2	0	0	0	0
	C	10	0	10	10	0
	D	18	0	27	27	0
	E	23	17	9	9	0
	Total	63	8	14	8	0
Tefoq	*A*	15	53	7	63	0
	B	13	23	23	46	0
	E	13	38	15	54	0
	Total	41	39	17	58	0
Kareg	*A*	9	1	2	33	0
	C	3	0	0	0	0
	D	7	0	0	0	14
	E	8	0	50	50	0
	Total	27	4	22	26	4
Total	*A*	51	21	13	35	0
	B	43	11	11	22	1
	C	28	0	9	9	0
	D	42	0	7	7	14
	E	68	14	11	26	0

From Tables II and III, it appears that in the cases of *E* and *D*, and of *C* in the Zalof series, at least, the appearance of imagery of the original group was correlated exclusively with the number of classifications which the observer had made; while in the cases of *A* and of *B*, the profusion of series-imagery depended to a large extent upon the type of classification. In *A*'s case, group-imagery was by far the most frequent with hesitant classifications, while in *B*'s case

it was most common with negative classifications, especially of the cautious type. With *B*, the failure of an essential feature to occur was in many cases marked by the superposition of a visual image of the feature upon the altered region. *C*'s results are too few to indicate definitely whether a correlation occurred between her group-imagery, on the one hand, and type of classification—or number of classifications, on the other hand.

c. The extent to which the process of classifying was diverted from its course by the intrusion of striking variables: Table IV contains for every observer the per cent of classifications in which striking variable features were attended to, with or without a resultant negative tendency. Here again, extensive individual differences are apparent. *C* and *D* in no instance reported that a negative tendency followed upon their attending to a striking variable, and (excepting for *D*, in the Deral group) it relatively seldom happened in the case either of *C* or of *D* that such a feature even stood out prominently to attention for ever so short a time. The reader will remember, of course, that neither *C* nor *B* participated in the experiments with the Tefoq series, which was more complex than the others, and in the course of which *A*, *B*, and *E* attended much more often to striking variables than they did in the other three groups. Nevertheless, if we compare the results of *D* and *C* in these last three groups with the results in the same groups of the other observers, we find that the former—especially *C*—paid least attention to variables. *A* attended most often to variables; in his case the standing-out of a variable was usually followed by a negative tendency and sometimes (two instances) by a spoken negative response, *B* stands between *D* and *C*, on the one hand, and *A* on the other. In *E*'s case, the attracting of attention was followed by a negative tendency in a small majority of instances; in two cases, he actually responded aloud with a negation. In the case of *B*, the negative tendency followed in *ca.* fifty per cent of cases.

d. The relative dominating-power of the process of classifying, and the affirmative or negative response-tendency. Table V indicates for each observer the per cent of the total number of classifications which were cautious, on the one hand, and premature, on the other hand.

TABLE V

This table shows the percentages of classifications of each type,—premature, facile, cautious, hesitant.

Observer	*Total number of classifications*	*Per cent premature*	*Per cent facile*	*Per cent cautious*	*Per cent hesitant*
A	51	25.5	37.2	17.7	19.6
C	28	17.8	57.3	10.7	14.2
B	43	13.9	41.8	18.8	25.5
D	42	11.9	28.5	31.1	28.5
E	68	4.4	51.4	14.8	29.4

Since a premature reaction was one in which the affirmative or negative response overcame the classification-process itself, it appears that the tendency to respond was relatively most potent in the case of *A*, and least potent in the case of *E*. The descending order of the observers is: *A, C, B, D, E*. When we compare the proportion of premature reactions with the number of cautious and hesitating reactions we find that a fairly close correspondence obtains between the descending order of premature, and the ascending order of cautious, reactions. *C*, who frequently reacted in very rapid fashion, constitutes one exception; the other is *E* in whose case it was difficult to distinguish cautious from facile reactions, and hence the figures in the table are less certain.

When we compare the classification-times of the different observers, it appears that the observers in whose cases the response-tendency was most frequently prepotent over the classification-process were the most rapid classifiers. Table VI contains the classification-times of every observer, for each type of classification; and Table VII indicates the descending order of rapidity of the observers, for every type of classification. A fairly close correspondence obtains between the descending order of rapidity, and the descending order of prepotence of reaction-tendencies, as shown in Table V.

TABLE VII

Descending order of rapidity of the observers in every type of classification

Facile		*Cautious*		*Hesitant*
Aff.	*Neg.*	*Aff.*	*Neg.*	
C	*C*	*B*	*E*	*B*
A	*A*	*A*	*C*	*A*
B	*B*	*E*	*B*	*E*
D	*E*	..	*D*	*D*
E	*D*	..	*A*	*C*

TABLE VI

Classification-times

		Facile		*Cautious*		*Hesitant*
		Affirmative Sec. M.V.	*Negative* Sec. M.V.	*Affirmative* Sec. M.V.	*Negative* Sec. M.V.	Sec. M.V.
Zabof	*A*	1.48±0.52	1.28±0.40	4.40±0.00	5.90±1.70	1.30±0.10
	B	1.40±0.47	1.58±0.39	3.00±0.00	2.00±0.50	2.50±0.40
	C	0.90±0.14	1.20±0.16	0.00±0.00	0.00±0.00	0.00±0.00
	D	1.78±0.00	2.30±0.10	2.60±0.20	2.70±0.20	4.91±2.34
	E	1.25±0.00	1.62±0.55	4.00±0.00	1.60±0.00	3.17±0.59
Deral	*A*	1.60±0.20	1.00±0.00	2.20±0.00	1.90±0.10	2.90±0.30
	B	.....	.....	.....	.....	.....
	C	1.50±0.35	0.90±0.10	0.00±0.00	0.00±0.00	5.90±4.00
	D	0.00±0.00	3.50±1.00	5.80±1.00	4.10±0.90	6.00±1.40
	E	2.15±0.57	2.42±0.39	2.97±0.22	0.00±0.00	5.81±2.48
Tefog	*A*	1.30±0.30	1.80±0.30	4.00±0.80	5.00±0.00	5.90±1.80
	B	1.90±0.25	1.60±0.30	0.00±0.00	4.00±0.00	3.40±0.80
	C	1.00±0.00	0.00±0.00	0.00±0.00	2.70±0.30	0.00±0.00
	D	.....	.....	.....	.....	.....
	E	5.00±0.48	2.80±1.10	8.20±0.00	0.00±0.00	7.60±3.20
Kareg	*A*	1.10±0.16	1.07±0.09	0.00±0.00	0.00±0.00	0.00±0.00
	B	.....	.....	.....	.....	.....
	C	.....	.....	.....	.....	.....
	D	0.00±0.00	1.00±0.00	4.60±0.60	3.00±0.00	6.60±3.40
	E	2.30±0.70	1.20±0.00	0.00±0.00	0.00±0.00	3.30±1.30
Total	*A*	1.37±0.29	1.08±0.26	3.53±0.80	4.20±0.90	3.36±0.40
	B	1.65±0.36	1.59±0.34	3.00±0.00	3.00±0.50	2.90±0.60
	C	1.13±0.24	1.05±0.13	0.00±0.00	2.70±0.30	5.90±4.00
	D	1.78±0.00	2.40±0.55	0.00±0.00	3.20±0.55	5.83±2.38
	E	2.70±0.58	2.01±0.35	4.33±0.60	1.60±0.00	4.97±1.89

F. SUMMARY. 1. The process of classifying,—the observers' manner of perceiving the classification-figures,—consisted in a series of experiences in which attention passed in order to the regions of the classification-cards whose counterparts in the group proper had contained essential features; *i. e.*, it consisted in a successive becoming focal—definite and intensive—of these regions. This course of attention persisted either until the regions of all the essential features had been examined, or until an essential feature failed to stand out when the regard passed to its region.

2. The process of classifying was sometimes complicated by the presence of components other than the perceptions of the classification-figure. These contents included vocal-kinaesthetic and auditory images of words which designated the observers' findings; kinaesthetic sensations of the eye-move-

ments involved in examining the figures; kinaestheses of internal imitation of the figures; and concrete visual and verbal imagery of the original series.

3. The process of classifying was initiated only by the hearing of the experimenter's instructions and by the perception that the figure had been exposed. When this process reinstated itself after an interruption, however, its recurrence was at times preceded by concrete visual or verbal imagery of the region of the figure which had not yet been explored; and sometimes by verbal imagery of self-instruction. It seems probable that imagery of the first type is to be regarded as an initial term of the reinstated process of classifying, rather than as imagery of intending to continue the exploration, or of setting up a goal-idea.

4. The component details of the process of classifying,—the conscious experiences that the classification-figures contained or failed to contain specific essential features, etc.,—consisted in the behavior in consciousness of the separate features of the classification-figures. This behavior depended upon the extent to which the regions of the essential features resembled the corresponding regions in the group-members. *a.* If a feature which the observer had found to be present in all of the group-figures was definitely present in the classification-figure, it flashed out into clear consciousness as attention passed to and over its region; and this facile and often very brief standing-out of the figure constituted in itself the affirmative answer to the question 'does it have the essential features?' which was present as the characteristic course of attention in the classification. It was sometimes complicated by the presence of additional contents—imagery of the original series, or contents which reinforced the observation of the figure itself, such as verbal imagery, kinaestheses of internal imitation, and the like. Again, it was often followed by a verbal affirmative response, imaged or overt. If the observation had not been completed, the attention shifted rapidly and readily on its course; and if the observer did not note the absence of any essential feature, an affirmative response was verbalized.

It sometimes happened that the affirmative response was verbalized before the course of the process of classifying was completed. Thus a premature reaction was given; the affirmative reaction-tendency overcame the process of classifying. Even here, however, the uncompleted process usually reasserted itself, operating on a last percept of the disappearing stimulus, or upon concrete visual imagery of the stimulus.

In some cases observers reported classifyings of a type in many respects the opposite of the premature one. The successive features were noted in a slower and more painstaking fashion; the affirmative response followed less readily and rapidly.

The affirmative response itself usually consisted only in the ready standing-out of the feature, and the rapidity and uncontestedness with which the attention left it; it merged without delay into the continuing classifying-process. Sometimes, however, the attention-processes were complicated by additional components, such as relaxation, pleasantness, kinaesthesis of nodding, of waving the hand, or internal 'welling-up.' Verbal imagery of 'yes' was often present; and under certain conditions—usually, when the feature was the last one on the attention-route—a spoken 'yes' followed.

b. When a figure of the classification-series lacked one of the essential features, or possessed it in a crucially dissimilar form, the attention-course was arrested at that region, which became unusually clear. This halting of the attention constituted the negative answer to the question (present as the characteristic course of attention) of 'does it have the essential features?'; and it was usually followed immediately by a negative response and an abrupt termination of the attention-course. Occasionally the arrest of attention on the altered region was accompanied by more or less intensive kinaesthetic and organic sensations. Or imagery occurred of the region concerned as it had appeared in the group-figures themselves, and of supplementing the findings in the present figure.

In some cases, however. the negative response was not verbalized aloud, but instead the course of the classifying-process continued, in a relatively painstaking fashion.

The negative response itself was usually nothing more than the above-described sharp arresting of the attention, with the subsequent verbalized 'no.' Sometimes, however, it was complicated by the presence of additional contents,—more or less emphatic and intensive kinaesthetic and organic rejectings of the figure, verbal imagery of 'no,' and of words which expressed the reason for rejecting the figure.

c. When an essential feature was markedly dissimilar, yet neither definitely present nor absent in the classification-figure, attention remained persistently upon the region in question,—the consciousness of the region lasted, and it became very focal. When after a time the exploration of the figure was continued, attention was cautious and deliberate in its course, and it frequently returned to the altered region. This pro-

longed arrest upon the altered region was usually marked, sooner or later, by the presence of strains and tensions and affective contents of unpleasantness. Imagery of other sorts also occurred on many occasions; verbal imagery of questioning the nature of the altered aspect, or of fragments of the definition, or of sketchily present argument, as one aspect after another stood out in the altered region, or of silent vocalization of these aspects; and visual imagery of the corresponding region in figures of the group proper.

5. It sometimes happened that conspicuous novelties or strikingly altered non-essential features stood out in consciousness during the examination. These features were sometimes merely present in a marginal fashion, without influencing the main course of attention. Again, they became for a time very focal, but were not followed by affirmative or negative responses. Their focal presence was sometimes followed by verbal imagery of their non-essential character, with turning of attention to other regions. Usually, their standing-out was followed by a more or less energetic negative tendency, which was at times actually verbalized aloud.

6. The observers sometimes merely described the affirmative or negative responses without labelling them. In other cases they described them and also labelled them, sometimes as familiarity or unfamiliarity of the feature in question, but usually as acceptance or rejection of the latter, feeling that it was wrong, etc. The application in retrospect of some label to the experience depended largely upon the additional presence of striking kinaesthetic and organic and affective or other contents or factors; it also depended to some extent upon the individual observer. The nature of the label which was applied depended in part upon the individual observer; but it tended to be closely harmonious with the prevailing direction or course of consciousness, in this case, the process of classifying. The observers were in an "is-it-a-Zalof?" situation, and the normal interpretation of the experiences of arrest, or of ready passing on, of attention was obviously one of rejection or of acceptance, of feeling of figure being right or wrong, etc. The observers were not in a recognizing—a "have-I-seen-it-before?"—situation and hence the infrequency of the label of familiarity or of unfamiliarity is not surprising.

7. Two main sorts of process were thus operative in our classification experiments. One of these was the characteristic course of consciousness in the classifying as a whole; and the other was the response-tendency, which appeared with the standing-out of any feature. The former was more forward-

moving, more dynamic; the latter, when it separated out from the former, tended toward the static ('conscious attitude'). It frequently failed to realize itself, however, the classifying-course continuing instead. When the response (especially the negative response) was not thus prevented from realizing itself, it became richer in imaginal and kinaesthetic content, and merged into complex attitudes, which were labelled as familiarity, acceptance, or especially unfamiliarity, rejection, and the like.

Ordinarily, the process of classifying prevailed until its completion, but at times the response-tendency became sufficiently strong to interrupt it for a longer or shorter time, the response even being verbalized aloud.

The introspections reveal the fact that a certain interdependence existed between the main process of classifying and the affirmative and negative response-tendencies. While the negative response-tendency often appeared when attention went to the region of a striking variable feature, nevertheless it relatively seldom appeared here in sufficiently energetic manner to lead to a negative spoken response. Its appearance apart from the normal route of the process of classifying apparently meant that its energy was diminished. On the other hand, the appearance of such an energetic negative tendency was followed by a checking and a becoming more cautious of the main process itself, when the latter became reinstated.

8. Individual Differences: Our observers presented numerous individual differences, both structural and functional. Structurally, they differed in the nature of the imagery which presented the members of the group proper; in the nature and modality of the imaginal reinforcement of the figures under observation; in the nature of the contents which entered into the experiences of doubt and hesitation; in the frequency and nature of personal reactions to the figures; and in the nature of the imaginal and sensory contents which accompanied experiences of affirmation and negation. The functional differences were concerned with the extent to which the process of classifying was accompanied by imagery of the group proper; with the conditions under which such imagery occurred; with the extent to which the process of classifying was diverted from its course by striking irrelevancies; and with the relative dominating power of the process of classifying, on the one hand, and of the affirmative or negative reaction-tendencies, on the other hand. With certain observers, the appearance of imagery of the original series depended upon the number of past experimental sittings with the series

in question; with others, it depended upon the type of classification, being more numerous with the hesitant or cautious negative type. In general, the observers in whose cases the response-tendency frequently overcame or delayed the main classification-process showed fewer cautious reactions; and their reaction-times were most rapid.

IV. Conclusions

The essence of the process of classifying, as this process occurred in our experiments, consisted in the manner of the observers' perceiving the object which he had been instructed to classify. This manner of perceiving consisted in the fact that the regions of essential group-features were stressed in consciousness, and that these regions behaved in consciousness in a fashion which depended upon their resemblance, or lack of resemblance, to the corresponding features in the group-members. In the former event, the regions in question passed in and out of consciousness in rapid and ready fashion, without retarding the course of attention. In the latter case, on the other hand, the course of attention was arrested sharply; these regions often persisted in consciousness, and they were frequently accompanied sooner or later by more or less focal and intensive kinaesthetic, organic, and affective contents which functioned in their conscious settings as definite rejectings of the figure.

This view is, we believe, in accord with those of numerous writers who hold that the generalizing-process is essentially a motor phenomenon. The classifying of a novel percept with a group of previously experienced ones occurs in virtue of the fact that the former arouses a reaction which is identical with that aroused by the latter.[62] Within the writer's knowledge, the authors who have most persistently concerned themselves with the conscious phase of this motor response are Zetz and Müller-Freienfels. Betz[63] finds that in his own case, the motor reaction or 'attitude' is either projected out into space, *i. e.*, objectified, as a series of movements (whether kinaesthetically or visually conscious is not fully clear to the writer); or else it forms the basis of a feeling—*e. g.*, in the case of green, a 'calm, agreeable feeling.' A concept is a 'projected' attitude; and a novel phenomenon is subsumed under a concept when the attitude which it evokes 'fits in' with the concept-attitude (pp. 210 ff). The meaning for consciousness of the expression 'fits in' is not clear to the writer. Whether it means an inference on the part of the systematizer, or an actual consciousness of 'fitting in' on the part of the experiencer, we cannot say.

Müller-Freienfels maintains that the motor reaction has a feeling as its conscious symptom; and he uses the term *Stellungnahme* as an

[62] *Op. cit.* footnote 2 p. 57, p. 24.

[63] W. Betz, Vorstellung und Einstellung. II. Ueber Begriffe. *Arch. f. d. ges. Psychol.* XX, 1911, 186-225.

expression for the combination of motor disposition and feeling-symptom.[64] Feeling is not sensation, nor is it a property of sensation; whether its essence consists in movement, he leaves open.[65] Sensory situations which arouse the same *Stellungnahme* are subsumed under the same concept. Here again, the writer is uncertain as to whether Müller-Freienfels uses the term 'same' in an inferential sense, or as referring to a consciousness of sameness.

If we attempt to translate our findings into the language of Betz and Müller-Freienfels, we would conclude that the 'motor disposition' 'set free' in the percept may be present to consciousness in terms of the manner in which the observer perceives the object, *i. e.*, the shifting parts of the latter which stand out, and the duration and intensity and focality of the standing-out of the several parts, or in terms of kinaesthesis of the observation as well.[66] We would maintain that the 'feeling' referred to may possibly be analyzable into the peculiar temporal and focality aspects of the percept which constituted its being included in the group, or into those which constituted its being rejected; and we would suggest further that the presence in addition of an awareness or attitude of sameness, or of 'fitting in,' is a function of the momentary conscious situation of the observer, and of the use which he is to make of the experience. If, *e. g.*, he is told to identify the object, his manner of perceiving it will be supplemented by verbal or kinaesthetic assent, which constitutes an awareness of sameness. If he is making a different use of the percept (*e. g.*, examining its features for specific points[67]), he will have no such awareness of its identity with the group.

[64] R. Müller-Freienfels. Typenvorstellungen und Begriffe. *Zeitschr. f. Psychol.*, LXIV, 1913, 386-433.

[65] R. Müller-Freienfels. Die Bedeutung der motorischen Faktoren und der Gefühle für Wahrnehmung, Aufmerksamkeit, und Urteil. *Viertelj. f. wiss. Phil.*, XXXVIII, 1914, 215-253; 335-371.

[66] We believe that observers vary with respect to the manner in which such motor phenomena are present to consciousness, *i. e.*, whether they are present as shifting visual (or auditory) perception, or as kinaesthesis, or both.

[67] *Cf. op. cit.* footnote 2 p. 57, pp. 97 ff.

RESEARCH IN PATHOLOGICAL PSYCHOLOGY AND BIOCHEMISTRY[1]

By Edward Cowles, M. D.

Research in the pathology of mental disease has a history of peculiar interest; progress has been indirect and difficult in this branch of the medical sciences because of both favoring and conflicting influences. In modern psychiatry laboratory investigations were first employed to find in anatomical pathology explanations of mental disorders. Great progress has been made in the 70 years since Griesinger published his work on mental disease. During the first 20 years of that period he was the first to establish psychiatry upon the basis of scientific research and pathological principles. During the next 20 years several contributing movements, having their genesis in the advancement of general medicine, gained headway or had their inception; in America, a new interest arose in pathological investigations in institutions for the insane, and among them the plan was formed at the McLean Asylum (Hospital after 1892) to add to the pathological laboratory two other laboratories in order to combine researches in physiological and pathological psychology and biochemistry with the clinical work. In 1889, after ten years of preparatory observation, under the inspiration of general medicine and the "new psychology," these combined laboratories were fully organized and equipped for beginning researches by the methods then available.

In the laboratory movement of the time the new combination here described was the outcome of definite concurring influences, which, with their sources, should be recognized for their historical significance. The McLean Hospital laboratories reflected contemporary trends leading to the momentous changes which are now revolutionizing ideas that have long dominated psychiatry; it is important to note what these changes have contributed to a stage of progress that has been slow in awakening the attention of alienists. In the asylums, as they were constituted in the decade of 1880-90, the medical service was concerned with a number of quite distinct major problems in

[1] An account of the laboratories of the McLean Hospital. Reprinted from The Institutional Care of the Insane, 1916, Vol. 2, pp. 618-636, with added notes and references.

theory and practice; these related (1) to the methods by which explanations of mental disorder were sought in the findings of the pathological laboratory; (2) the generally accepted psychological conceptions and formulæ descriptive of mental physiology and of mental diseases for their classification; (3) the physical conditions associated with mental diseases and their causes with respect to the principles of general physiology and of general medicine; (4) the practical methods of treatment of the different forms of these diseases.

The General Position of Psychiatry in America in its Theory and Practice, 1880-90

The attitude of the alienists toward their problems was one of newly stimulated interest. Some of the difficulties met with and the obstructive effects of certain misleading contradictions in the formulations of the problems should be noted; they will appear in the following account of the McLean laboratories as an example of the general efforts toward progress. The purpose, course pursued and results accomplished can be better understood by indicating here the observations concerning the nature of the major problems that prompted the laboratory investigations. (1) The alienists were subject, by general consent, to the claims of pathological anatomy as the master science in general pathology; they looked to it for a basis of scientific psychiatry, but it was hope deferred, and they remained under the reproach of being unscientific. Although the new science of neurology, claiming psychiatry as a part of itself, was then bringing much aid, yet within 20 years thereafter it reached one of its authoritative conclusions that "pathological anatomy is of more academic than practical interest to the psychiatrist . . . the burden of our work should be away from morphology and more in physiologic lines." This of course did not deny the essential value of pathological morphology in association with these fields of investigation.

(2) Mental physiology, with true explaining principles in the physical mechanism, was the immediate need of the alienists for the investigation of abnormal behavior, and the first step in "tracing back symptoms to structural changes in accordance with the principles of general pathology." Lacking such explanations and limited to descriptive classifications of clinical symptoms, the alienists avoided the speculations of academic psychology which gave little aid. Thus, in common with all the world, they adopted the general empirical conception of the intellect, feelings and will; and in terms of these conceptions they framed their descriptions of the mental activi-

ties. Twenty years prior to the time under consideration Griesinger was making the bequest of his conceptions of mental pathology universally followed in modern psychiatry; his formulations of the symptom-complexes of melancholia and mania still dominate our descriptions of melancholia as "states of mental depression," and mania as "states of mental exaltation."

These phrases condense one of the most fundamental and general concepts of psychiatric theory into two words, "depression" and "exaltation," used as physical metaphors for the contrast of the feelings of pain and pleasure, which present a true "oppositeness" of *quality* of feeling or emotion—both normal and morbid. But while "depression" always fitted melancholy states, "exaltation" was found to be far from constant in maniacal states and not to fit the physical facts; and the make-shift word "excitement" came into use in its motor sense. To-day we frame our descriptions around "depression" and "excitement," making a false differential of emotion and activity, which always seems to imply a *quantitative* contrast of decrease and increase; whereas, on the contrary, in the states of real physical depression with constant mental pain there is always increase of its intensity and often motor agitation, while in the states of excitement—of shifting emotion and motor activity—there are further real decreases of integrity of both mental and physical functions and descent to "deeper levels of destruction." Such are some of the contradictions in this slough of despond for scientific psychiatric thinking and experiment. There is no way of escape but to abandon it. It is an inheritance from the most primitive experiences of an ever-widening range of such concepts of the feelings, as of pleasure and pain, joy and sadness, hope and fear, as expressed in such figures of speech as exaltation and depression, being uplifted or downcast, and innumerable analogues of highness and lowness in the moral sense; thus have been drawn into the complex conceptions of the feelings the physical meanings of such ambiguous words.

There can be no change in the common usage of such picturesque analogies and physical metaphors; but in the present instance they are destructive and unfit. The remedy must be by passing from facile description to the explanatory level; and to the advancement of laboratory investigations in psychology, psychiatry and physiology are due the definite signs of emergence in recent years. In 30 years, or since the beginnings of Wundt's psychophysic experiments to Pawlow's and Cannon's latest discoveries in the physiologic relations of protective bodily changes to emotional reactions, there has been a revolution of ideas through the contributions of physiology to psychiatry.[2]

[2] "For a number of years, and particularly since the publication of Pawlow's work on the effects of emotion upon glandular action, there has been a wide and increasing interest among psychologists and physiologists in the more intimate bodily mechanism underlying emotional processes. This movement has coincided with a rapidly growing

(3) The physical conditions associated with mental diseases were of constant interest to the alienists; systems of classification were attempted, based upon the etiology of mental disorders as sequences of general diseases. This tended to aid in prompting the purpose of the laboratories which grew out of the conditions observed in the preceding ten years, showing the need of physiological investigations to explain the psychological problems. Some of the fallacies of the conceptions of them have been noted in the foregoing statements to show the reasons for the attempt to apply new methods. The attitude of inquiry is indicated by the position taken in respect to Griesinger's description of contrasting mental states before quoted. Beginning in 1885, and since then carried forward in annual courses of lectures and in projecting these laboratories, the view has been presented as the belief of many alienists that melancholia and mania constitute one disease, with stages declining to dementia. It was proposed two years later, in an unpublished paper on classification, to amend Griesinger's formulations to read "states of depression of feeling" and "states of derangement of intellect," for the reasons that while the persistent mental pain characteristic of the first stage reflects truly the bodily malaise, the second stage is characterized by graver derangements of thinking and unstable emotional states, showing their disordered relations with the bodily ill-being and the losses of functional power and control. This was known to have been essentially the position taken by Griesinger, but it can be better appreciated in the light of later understanding by newly studying his writings, which reveal his vigorous but unheeded protest against the immediate misinterpretation by his contemporaries of his psychological meanings. Limiting the present view of the situation to what it was in the decade prior to 1889, it can now be seen that he used the words "depression" and "exaltation" in their figurative sense, as did the contemporary alienists, psychologists and all the world besides, following the ancient and fixed usage. But he meant simply "mental pain" and the emotional contrast; he did not mean an oppositeness of "mental torpor" and "mental irritation"—an "increase" or "decrease" of some-

appreciation among physiologists and physicians of the organic significance of certain of the so-called ductless glands, and of the physiological importance of gland and muscle tissue in general. Already the discoveries made have quite revolutionized many of the ideas of a generation ago, and the chapter seems hardly more than begun." James R. Angell, Review of Cannon's work on "Bodily Changes in Pain, Hunger, Fear and Rage. Recent Researches into the Function of Emotional Excitement;" and Crile's work on "The Nature and Origin of the Emotions." *Science*, Nov. 12, 1915.

thing. Yet the psychiatric world still clings to the ancient, unscientific conception of a physical *something, up or down,* although the physiological investigations of the laboratories have been proving for 30 years that Griesinger was right. The following narration of events will show the course of progress, and what was done with the ancient conceptions when the new psychology brought psycho-physic experiment into psychiatry.

(4) The most significant indication of the attitude of the alienists of 30 years ago toward general medicine was their position with respect to the practical methods of treatment. They had been the leaders in the adoption of the "supporting treatment" for many years in advance of general medicine—a logical, though empirical, expression of their comprehension of the physiological principles of the energy concept. Here was the basis of the vogue of the neurasthenic concept developed in the science of neurology. This was the crux of the matter from which came the inspiration to research in the chemistry of nutrition. The "fatigue question" and the "nutrition question" were "believed to be of primary importance in psychiatry." Hence as an outcome the laboratory of biochemistry. The psychological laboratory was added by direct importation from the laboratory of Ludwig at Leipsic, through Dr. Stanley Hall and the department of psychology at The Johns Hopkins University. These preliminary comments have a certain historical interest; they are also needed not only to show the origins of this laboratory movement, but to state the problems with which it had to contend, and which essentially form the basis of the conclusions that emerge from the broader review of the whole matter.

NOTE.—The main events on the medical side of the laboratory movement at its beginning, indicate the conditions under which the aid offered by psychology had to make its way. While some of the earlier alienists, usually chosen men of attainment in general medicine, gave special attention to pathology it was not until 1868 that Gray at Utica, first in this country, organized a department for such research by appointing a pathologist; this was continued during his service till 1886. Through this period there was increasing interest in such investigation by individual members of the medical staff in some of the asylums. But the most stimulating influence of the time was the work of Folsom in Massachusetts, then Secretary of the State Board of Health, which included the supervision of the care of the insane; his historical monograph on "Disease of the Mind," 1876, showing European and American progress, and his observations, especially of English and Scotch methods, aroused great interest; many of our younger alienists went to study them during the next decade.

At this time the pathologists were non-resident, appointed for occasional service. The Government Hospital in Washington made a great

step in advance by establishing a permanent department, the most efficient of the time, for scientific work with the appointment of a special pathologist in 1883. This work in clinical pathology was of the best order and was maintained until 1906 when the scope of the department was extended by the appointment of an expert psychologist experienced in pathological psychology and not a physician, to be the scientific director with various assistants. This combined service has sustained its hopeful purpose. This event is significant of the long cycles of time taken for such an innovation as that of pure psychology into psychiatry; Dr. Franz had been for four years before the first expert psychologist in such a service at McLean Hospital, where twenty years before Dr. Noyes was appointed pathologist also to direct especially the chemical research as well as to apply the psychology he had learned from Stanley Hall at Johns Hopkins University.

In the next following decade, 1890-1900, the general movement became more manifest, and resident pathologists were appointed. At Kankakee, Dr. Meyer took charge in 1893, and went to Worcester in 1896; at Danvers, Dr. Worcester was appointed in 1895; at Indianapolis a spacious pathological building was opened in 1895; and at the Sheppard and Enoch Pratt Hospital, Dr. Paton was appointed in 1899; all of these and other like efforts have established their value as important adjuncts in the progress of the clinical work. It appears in all that the initiative purpose was for scientific investigations in pathology.

This was also the essential purpose of the largest undertaking in that decade, the State Pathological Institute in New York city in 1895. The State Commission and Dr. Van Gieson, the director, had ambitious and comprehensive conceptions of the main purpose of this central influence for guiding the scientific work of all the hospitals. Progress was made in organizing the pathological work; there were interesting beginnings in the study of psychological problems and of chemical investigations. But its history shows that the disadvantages of its being detached from a clinical service and the danger of failure in its being supported in its costly location caused its removal to Ward's Island, where it could be in connection with hospital wards assigned to it, and be afforded facilities for developing a practical field for co-ordinating all the investigations which would invite attention in an economic association with a clinical service; this would obviously claim existence for its own sake. This original purpose was promoted and broadened; the way of progress opened wide under the direction of Dr. Meyer who came there from Worcester in 1902 and was succeeded in 1910 by Dr. Hoch with an experience of twelve years in the McLean laboratories and five years at Bloomingdale Hospital. The trend of progress of this great establishment is indicated by the change of name from Pathological to Psychiatric Institute. The facts accomplished in its course of twenty years need no recital here of what it has done in applied psychology. These references to the origins of the laboratory movement and the concurring events in the quarter century before 1900 indicate the circumstances contemporary with the following account of the McLean laboratories. Out of these labors of that time has come the later remarkable development of reception wards, and psychopathic hospitals tending to the provision of a psychopathic building in every hospital. The significance of all this is very great, and the appeal to psychology, the master science of psychiatry, and points to the need of trained psy-

chologists, as well as pathologists in the laboratories. Every date mentioned implies years of preparatory projects obstructed and delayed; the following history shows twelve years of active work in the combining of researches and prior years of preparation before 1900, in the McLean laboratories. Up to that time such a combination of psychology and chemistry with pathology and the clinic had not been projected elsewhere. It was a few years later there when first a trained psychologist, also a teacher of neural physiology, was persuaded to enter this special field for a professional career, in this country, and later one other followed him; these, with a few others more recently, amply justify the coming demand for this great service to psychiatry.

The Organization of the Laboratories

The new laboratories at the McLean Hospital were early attempts to combine the methods of physiological, biochemical and psychological experiment, under the principles of general medicine, in the clinical work in such institutions. The general progress made was noted in the annual reports; of special interest are those from 1888 to 1892, describing the establishment of the three laboratories, and a review of the work of the hospital in the reports for 1901 and 1902. Biological chemistry and physiological psychology were held to have an essential dependence upon each other. The conception of the chemical laboratory as a clinical aid in psychiatry had a longer incubation and was the direct expression of the neurasthenic concept, or, better, the energy concept. Here, as before noted, there was a direct sequence of events. From the time of the "supporting treatment" and Griesinger's recognition of the principle of reduction of energy in the relation between melancholia and mania, the energy concept had been gaining its place of fundamental importance in general medicine, and has held it in the practice of psychiatry, though much obscured and mostly lost to sight in theory.

The aims of the combination of the laboratories were comprehensively stated in a report on the psychological laboratories in America, contributed to the *Année Psychologique* in 1894 by Dr. Delabarre, in which the McLean Hospital psychological laboratory and its equipment were described as follows:

"The purpose of establishing and developing the laboratory has been carried on under much difficulty, naturally due to the newness of the attempt to combine with psychiatry the other departments of scientific medical research. The pathology of the terminal stages of insanity must be studied as heretofore, and it is necessary to add that of the initial conditions which lead to mental disorder. Such studies must therefore be combined with physiological psychology in the attempt to determine the exact nature and causes of departures from

normal mental function. Also in the dependence of these changes upon general physiological processes, and in order to take into account all the elements of vital activity involved, it is supremely necessary to study both physiological and pathological chemistry in their direct and indirect relations to mental changes. It will be seen by the foregoing report that the fatigue question, and its relation to auto-intoxication, is believed to be of primary importance in psychiatry. It is inevitable that progress must be slow in developing these several concurrent lines of inquiry; but the researches already begun are most interesting and promising, and encourage the hope that the work which is contemplated will so effectively combine them all as to yield worthy results." [3]

The laboratory, with its two purposes, was described by Dr. Delabarre as "the only one in America which united psychiatry and physiological psychology. In Germany there exists only one like it—that of Professor Kraepelin at Heidelberg. It attempts to combine the studies of the clinic and of neurology with those of chemistry on the one hand, and with those of psychology on the other."

In a lecture on "Neurasthenia" in 1891, and in other papers,[4] there is an extended discussion of the energy concept as it is involved in the successive reductions of functional capacity in neurasthenia, melancholia and mania, considered as stages of one disease—meaning that a *neurasthenic condition* underlies all of these phases.

The laboratories were under the direction of Dr. Noyes, appointed in 1888 and continuing till 1893, including that of pathological anatomy; and a seminary was organized by the medical staff for study in psychology and psychiatry. The equipment for psychological experiment was guided by that of Dr. Hall at Johns Hopkins University, and at Harvard Medical School, aided by the counsel of Dr. Bowditch and Prof. James; the chemical work had the valuable advice of Dr. Wood and Dr. Chittenden. The direction of the three laboratories was continued by Dr. Hoch for nearly twelve years, beginning in 1894; during nearly two years in Europe, his studies, mainly in pathology at Strasburg, and at Heidelberg with Nissl, had been extended to special preparation for the service at McLean Hospital by devoting time to the work of Kraepelin, Wundt and Mosso. The provision of ample rooms

[3] "Les Laboratoires de Psychologie en Amerique," by E. B. Delabarre, *L'Année Psychologique*, 1895; also "Laboratory of McLean Hospital," by G. Stanley Hall, *Amer. Jour. Insanity*, 1895.

[4] "Neurasthenia and its Mental Symptoms," Shattuck Lecture, E. Cowles, *Amer. Jour. Insanity*, 1891; "The Mental Symptoms of Fatigue," *Trans. N. Y. State Med. Assn.*, 1893; also "The Problem of Psychiatry in the Functional Psychoses," *Amer. Jour. Insanity*, 1905. See also "The Mechanism of Insanity," *Ibid.*, 1889-91.

and equipment for research in the new McLean Hospital, opened in 1895, was justified by the early experience. The claim of the chemical laboratory to a place in clinical psychiatry was established by the investigations of Dr. Folin, who took charge of it in 1900, when he applied the methods of pure chemistry and gave it a recognized distinction. The development of the work as a whole was aided directly by the conceptions of the English physiologists. It was noted at the outset that the clinical questions were characteristically associated with causes producing neurasthenic conditions, and with recoveries through restoration of the general health and strength. As stated later by Dr. Folin, "the problem to be dealt with in such cases is very largely that of nutrition, and the nutrition question is fundamentally a chemical one; also that it is disorders of metabolism that have a large part in the derangements of nutrition and dependent functions of the nervous system; and it is to such derangements that disorders of the mental function may be due in many cases." The purpose from the first was to approach such problems from the side of general medicine and to determine "what conclusions can be reached concerning the important question whether any tangible relation between faulty nutrition or other faulty metabolism and different forms of mental disease can be established." This implies the study of the influence of functionally disordered bodily conditions and organic sensations causing alteration of the "sense of well-being" and "personality," and of the "sense of adequacy," producing obstructive interferences with the processes of feeling, thinking and doing. The reactions of the emotions were recognized, when first undertaking the joint investigations, as essential factors of the utmost importance, in "the changes in nervous reactions in health and disease, the relation of the mental element as to its interferences with these reactions, and the counter influence of bodily conditions upon mental states." The conclusion was drawn that "in acute neurasthenia and in true melancholia and mania there is always nutritional and toxic functional weakness, fundamentally, in the organism; it is from this that the influences arise which affect the conscious feeling and thinking, making these higher mental states the sensitive indices of the lower physical changes." [5]

[5] Op. cit. Neurasthenia and its Mental Symptoms, 1891. The quotation continues: "When all goes well with the organism and it is in a condition of unfelt equilibrium, the processes of thinking and feeling are adjusted, more or less logically, to the varying environment upon a basis of a sense of well-being and normal love of life. On the other hand, a morbid process may be started in these higher

In this view it was believed that all the operations, physical and chemical, of the nervous and mental mechanism, should be studied as being conditioned by the contributing and concurring activities in both fields, and as having a primary and necessary relation to the supporting energy. The conscious attitude of the moment, having its inseparable emotional factors, affecting both the mental response and the physical reactions, these in turn must condition, and may determine, a persistent affective tone, especially when of pathological intensity. "The phenomena of nervous life are the outcome of a contest between what we may call inhibitory and exciting or augmenting forces" (Foster, Physiology). Voluntary action is at all times the resultant of the compounding of our impulsions with our inhibitions (James).

The point of present interest is that these laboratories and their combination were simply outcomes of principles then generally recognized, but awaiting effective acceptance in psychiatry. The significant exception to this was that the energy concept which, having given psychiatry the leadership as its long-used practical guide for treatment, had gained only a slow and limited appreciation of its special physiological and biochemical import for mental diseases. The result followed that psychiatry has engaged itself in working out other trends of

activities, in a previously healthy and strong organism; but until the organism itself suffers a change to the specified nutritional and functional weakness there can be no such mental symptoms as are being studied here. Normal mental activities cannot produce 'mental symptoms' except by first causing the characteristic 'weakness' somewhere in the physical basis of all of them."

It is of great historical interest in this connection that one who newly reads Griesinger's conceptions of more than 70 years ago may trace the substantial evidence throughout of their underlying continuance and growing force to the present time. The words he wrote in 1861 have lost none of their significance: "I would therefore beg the readers wherever doctrines, pages, and even chapters, occur similar, or nearly similar, to what they may shortly before have read in books or journals, simply to compare them with the first edition of this work which appeared in 1845." Describing the states of melancholia as most frequently appearing to be the direct continuation of some painful emotion dependent upon some external influences, he notes the cases without apparent moral causes in which it "does not originate as their direct continuation, but only shows itself after these affections have wrought considerable disturbance in the functions and nutrition of the nervous system, or have undermined the entire constitution." We have learned to distinguish neurasthenic conditions from the "hypochondria" of those days; Griesinger observed that the states of painful emotion may "proceed from a strong *feeling of bodily illness.*" Going further, he regarded the "states of mania as engendered by melancholia" and as a "still deeper destruction;" he never lost sight of the principle which is fundamental in all progress in the modern treatment of insanity.

inquiry and has neglected the study of its most pregnant problem, leaving it to the physiologists and the chemists to be solved for us.

The Chemical Laboratory

The chemical laboratory was the one first conceived to be a clinical need. Psychiatry was not yet ready for biochemistry 25 years ago, nor for explanations in disordered metabolism of morbid mental moods and activities; neither was organic chemistry yet able to offer practical aid to the mental clinic. But the principle being established and the way opened for its methods, the later history of these laboratories shows the somewhat indirect and obstructed path by which psychiatry is now coming to know its need. In the last 20 years there has been wrought a great transformation, culminating in the new conception of the psychopathic hospital. Dr. Folin gave new character to the expert application of pure chemistry to the problems of nutrition in psychiatry; his research work continued from 1900 to 1909, when, having an appointment in the department of biological chemistry in Harvard Medical School, he was succeeded by Mr. Erdmann; in connection with clinical pathology there was a steady advancement in the recognition and formulation of new and definite problems for chemical investigation. Established since 1900, there are now at least 14 other psycho-pathological laboratories in connection with institutions for the insane and defective in this country; in a few of them research in biochemistry is also included in their investigations, notably at Vineland by Dr. Goddard. It could not be learned at the time of the founding of its own chemical laboratory at the McLean Hospital that there was any other one of the kind in existence, in like institutions, aiming at a permanent association with the clinical work. The exception should be noted of the chemical laboratory of the new asylum at Claybury (1896), where the idea of Mott and Halliburton appears to have been to find what chemical changes took place in definite diseased tissues. Individual researches in such subjects were published prior to 1900, and under the influence of the later widely extended interest in pathological chemistry; but comparatively recent have been the efforts to discover metabolic abnormalities in the insane as a special problem by organized methods for prolonged investigation. It should be mentioned that in 1910 a laboratory of this kind was opened at the Munich Psychiatric Clinic, where the tendency of research is toward the study of changes in definite forms of organic disease. It can be said at least that the chemical laboratory at the McLean Hospital was an early attempt to carry out the "hospital idea."

The Psychological Laboratory

The psychological laboratory, under the conditions which grew up around it, as we are now prepared to see, pursued a productive course with well-known results. We are brought here to a point of critical interest in the great change in psychiatry in America—a movement still increasing in volume, though discarding much that is found wanting. The McLean Hospital laboratory typically illustrates some important factors in the general change. The psychological department, while pursuing its own special line of work in applying physiological experiment in abnormal psychology, had its course and development peculiarly subjected to collateral influences. To prove this one needs only to look through the brief summaries of work done, in the hospital reports, especially that of 1901 and the following years. The first of these concurrent and more or less controlling influences was in the clinical field, through bringing to this hospital the teachings of the Heidelberg school in 1897 as then developed, when Doctor Hoch was sent there for that purpose on his second mission. We know how these teachings spread and dominated psychiatric thinking in America. The greatest significance belongs to the fact that, on the one hand, the methods of physiological experiment had been brought years before through Stanley Hall direct from Leipsic, and his extended course of study in the laboratory of Ludwig, and moreover had been established here, coupled with concepts of biological chemistry; and that, on the other hand, certain methods of experimental psychology designed for the study of motor and intellectual function by measurement of time factors applied to psychiatry, came here later, also from Leipsic, by way of Heidelberg, but making no use of biochemical and little of physiological explanation. A great contribution to descriptive psychiatry was made by the doctrines of the Heidelberg school in arousing interest in descriptions of mental states. But they perpetuated with some changes of terms the long-accepted formulæ ascribed to Griesinger, except that Kraeplein passed wholly from the emotional criterion of Griesinger to that of activity by "increase or decrease" and "oppositeness," represented by "retardation" and "excitement." This appears to have led largely to the limiting of experimentation to reaction-time and motor effects, and to the insistence upon the analysis and classification of behavior thus differentiated into set clinical pictures and disease forms.

For the good of psychiatry, there should be noted in this connection the extraordinary fact that the extremes of divergence from the real teachings of Griesinger have grown out

of the immediate misconception of them when they were first published, and against which he made formal protest; but this was disregarded to the effect of making him responsible for an interpretation of his conceptions that he never meant, but that has ever since dominated psychiatry.[6] Believing that these states of melancholia and mania represented simply successive degrees of disorder of the mental and cerebral processes to the "deeper destruction" of their functional integrity, he used the term "depression" clearly in the qualitative sense of mental pain, not confusing it with the notion of something less than normal in contrast with something in "exaltation" more than normal in a quantitative sense. To the soundness of his real conceptions, contemporary with the beginning of the last half-century, is due their vitality and lasting influence.[7] These should not be forgotten when we recognize the fact that the greatest of the factors of progress formulated in the energy concept, with a steadily moving force toward culminating results, has been determining the long-

[6] Griesinger, Mental Diseases, second edition, 1861: "In employing the term 'states of mental depression,' we do not wish to be understood as implying that the nature of these states or conditions consists in inaction and weakness, or in the *suppression* of the mental or cerebral phenomena which accompany them. We have much more cause to assume that very violent *states of irritation* of the brain and excitation in the mental processes are here very often the cause; but *the general result* of these (mental and cerebral) processes is *depression* or a *painful state of mind.* It is sufficient to recall the analogy to physical pain; and to those who imagine that they make things better by substituting *'cerebral torpor'* and *'cerebral irritation'* for 'depression' and 'exaltation' it may fairly enough be objected that the melancholia there is also a state of irritation."

[7] Richard Mead, Medical Precepts and Cautions, 1755: "Medical writers distinguish two kinds of madness . . . but with this difference, that the one is attended with audaciousness and fury, the other with sadness and fear; and that they call mania, this melancholy. But they generally differ in degree . . . sometimes take each other's place and undergo various degrees of combination." Among the leaders in modern British psychiatry Clouston wrote 30 years ago of the "Descent to Dementia" through melancholia and mania. Twenty years ago Bevan Lewis wrote of melancholia and mania: "Yet, fundamentally different as these mental states would appear to be, we have little doubt that the process of reduction is the same for both, but in maniacal states the dissolution is to a *greater depth*—the difference is one of *degree.*" . . . "In mania we must recognize that the excitement of lower levels is one of disorderly, ungoverned license, indicative of the removal of the influence of higher controlling planes." Here are applied in psychiatry the physiological conceptions of Hughlings-Jackson; they are in harmony with Wundt's theory of functional capacity, and the teachings of Sherrington, which are having a notable influence upon modern thought.

impending revolution now going on in psychiatry. Its tendency to this in recent years has been simply a pervasive coordinating movement toward the principles established in general medicine, to which Barker refers with respect to the value of a functional conception of pathology; medicine becoming more scientific, classifications of "clinical types" are replaced by those of "a developmental or genetic character."[8] True to the genetic method are the new investigations and discoveries in experimental physiology and biological chemistry, proving the remarkable influences of the interdependence of mental and emotional states and physiological adaptations. The new knowledge of such normal reactions is of the utmost importance for psychology and psychiatry; interferences with normal mental reactions in the functional pathology of behavior demand the tracing back to the most fundamental of all the forces that act; there can be no action, however complex the "contest of forces," that is not conditioned by the degree of integrity of the potential energy. The new psychiatry must be founded upon such explaining elementary principles. Anatomical pathology gives us end results.

Proof of the foregoing statements appears in the operation of the concurrent influences that qualified the work of the laboratories here described. The second of these major influences in relation to the course of development of the psychological department was its immediate association with the biochemical research. This is a part of what is shown by the briefest outline of the later stage of progress and by the titles of papers published. The psychological laboratory was newly organized upon a special fund in 1904; under the direction of Dr. Franz, then appointed; it demonstrated the value of such research in pathological psychology through his qualifications as a trained psychologist and his experience in the teaching of nervous physiology. Continuing till 1908, he was then appointed to establish a like service at the Government Hospital in Washington. His successor in the former service, Dr. Wells, has maintained its continuity and carried forward its development by his well-known original investigations. The record of the work done in the three laboratories indicates their stimulating influence as intimate adjuncts of the clinical service. Certain subjects of research show not only the local

[8] Barker, L. F.: Methods in Medicine, *Boston Med. and Surg. Jour.*, June, 1905: "As medicine has become more scientific, the mind has ceased to be satisfied with such descriptive classifications as the clinical symptoms and syndromes represent and with 'clinical types' set up, and is ever on the alert to replace them by classifications of a developmental or genetic character."

trend, but the general movement in psychiatry toward the conceptions of general medicine.

While psychiatry has been seeing the remarkable extension of interest from a rigid morphologic neurology on one side, to the extremes of speculative psycho-analysis on the other, it keeps to its course on the middle ground of the graver insanities where psychology and psycho-pathology are held to the stern facts of associated physical disorders. The laboratory movement, for the bringing together of the long-disjoined paths of progress of psychology and psychiatry, has a significant example in the present work of the combined clinic and three laboratories at the McLean Hospital, an environment in which academic psychology has had some years of continuous collaboration.

Some particulars of this combined service should be cited here to explain the conclusion to which this review is leading. "A constant attempt has been made to find and apply such psychological and other scientific methods as can be made practical." "A stage of transition in the general laboratory policy was reached when the former conventional methods of experimental psychology proved to be of limited usefulness; the earlier methods of the experimental study of motor and intellectual function by measurement of time factors tended to be outgrown." "In accord with the tendency of the time, a wider use of physico-chemical methods in biological research" was adopted; "attention was given to serological investigations," studies of "psycho-galvanic phenomena in relation to emotional reactions" were published. "The principles involved in the biological point of view in psychiatry" were applied; "new means were sought for experimental observation," the laboratories were extended and refitted to meet the new problems. In the later chemical work a method for the determination of the "surface tension of liquids for biological purposes" was published, and a "research on alkylamines" was concluded. "Experimental studies in association opened new fields of research, one of these being concerned with the use of a method of this nature in different forms and stages of the psychoses, and the other with "the traits of personality which it reflects among individuals in general." "In the development of a method for the systematic observation of the personality, susceptible to quantitative treatment, emphasis was laid upon the actual mental difficulties to which the individual is subjected and their proper means of adjustment." "Recognizing the most hopeful tendency in psycho-pathology and normal psychology as founded on the conception of the mind as an adaptive mechanism, an experimental method is needed for the estimation of the adaptive reactions."

The process of applying the methods of normal psychology to the problems of abnormal conditions, and of testing the validity of current contributions to psychology, has had a free and liberal field and competent direction. "The clinical ideal of the study of the whole life and personality of each patient as an individual special problem has become also the psychological ideal." This implied "the need of studies in dynamic psychology, and the investigation of the relation of mental states to the disorders of digestion and nutrition." Time

was spent at the Carnegie Nutrition Laboratory in Boston. The immediately available expert aid of "physico-chemical methods in biological research" had its influence and "determined their wider use here in accordance with the now recognized tendency of the time." (From annual reports of the McLean Hospital.)

The productive results of the combined operation of these laboratories are traceable directly to the projects of the decade 1880-90; they justify the forecast of the essential value of the dynamic concept in psychiatry, although the recognition of it has needed the labor of many years to make its wider use the tendency of the time.

The outcome here is typical of the great interest that has arisen in a considerable number of the institutions throughout the country and of their increasing productiveness within a few years. The laboratories of the McLean Hospital and the U. S. Government Hospital have tended to specialize for the longer time in psychological studies, the former giving more attention than any others to biochemical investigations. A special significance also attaches to the events at the McLean Hospital because of the introduction there of the variations in the formulation of psychiatric doctrine brought from the Heidelberg school, and because of the results of the contact there of the still prevailing system of essentially descriptive psychiatry, with the movement for broader biological explanations. The tendency of the former has been to perpetuate the fallacies of metaphorical descriptions of behavior, and to continue to seek to differentiate new "disease forms" under new names while now becoming constrained to place its failures in a growing group of "unclassified forms"; the tendency of the latter is to the practical conclusion that a functional conception of mental diseases leads to treatment through the study of the whole personality of each individual case. "Psychiatry belongs to general medicine, and mental disease, like bodily disease, is not an entity nor an agency, but the result of normal forces acting under abnormal conditions; the problem requires the investigation of the developmental and genetic character of functional modifications."[9] Osler asserts: that "the battle ground of medicine in the near future will lie in the fields of clinical chemistry and metabolism."

Conclusion

The foregoing recital in outline of events in the progress of psychiatry has needed some detail to show their historical import. While the account in part relates largely to one line of

[9] Op. cit. "The Problem of Psychiatry in the Functional Psychoses," 1905.

advancement and to one institution, for the sake of its continuity and coherence, it is still only typical of the great movements and progress of the time. It is shown that in the march of development certain forces, alike in general medicine and psychiatry, and not less in psychology, have held their course, though with unequal steps. The historical meaning, revealed by a brief tracing of these trends to their recent leadings, betokens the momentous change now going on in the conceptions of mental diseases.

The problem of overcoming the barrier between mental physiology and mental pathology is one of the greatest importance to psychiatry. That medical training in psychology is desirable needs no saying. It is needed to consider whatever there may be in the methods of normal psychology that does not fit with the problems of pathological psychology.[10] What is there in the mental attitude of the psychologist which differs from that of the research worker in the physiological or physico-chemical laboratory, who has to deal with the physical facts of the mechanism of life?

The history of the laboratories here described reveals such a difference of attitude, and shows that both the psychologist and psychiatrist have been halting between the two leadings—the latter having to compound this disharmony in his practical work. In the course of these two trends of progress in modern psychiatry, there were conflicts and mergings, and the tendency to the emergence of clearer conceptions of scientific psychiatry. In the contemporary movements on the normal plane, beginning about 75 years ago, Johannes Müller, the founder of modern physiology, and his followers developed the methods of experimental research contributing to the rapid advancement in general medicine. Wundt, who had been with Helmholtz at Heidelberg, went to Leipsic in 1872, where Ludwig's laboratory became a center of interest for American physiologists. Academic psychology was seeking in the physical field explanations to support its views of psychic activity. Wundt established his laboratory in 1879 for applying the new mode of the exact methods of physical science to psychology.

The point of present interest in this movement is in the psychology of the emotions and the accepted fixed conceptions of their associated physical contrasts. Wundt's theory

[10] F. L. Wells, "The Advancement of Psychological Medicine," the *Pop. Sci. Monthly*, Feb., 1913. "The discourse of the medical man is one of problems, of the psychologist, one of methods; which under present conditions could scarcely be otherwise. The difficulty is that the methods of normal psychology and the problems of pathological psychology do not fit."

of the "three dimensions of feeling" expressed in pairs of "opposites,"

agreeableness	excitement	strain
disagreeableness	repose	relaxation

became a large problem of psycho-physical research. This great experiment and the vast literature written around it in 30 years in volumes of description and discussion, to fit with conscious experiences a like oppositeness of normal organic reactions, has been most productive in broadening the fields of research, although a negative conclusion has emerged concerning the "three-dimension theory."[11] The psychologists have done their part along their lines of approach to the recognition of the problem of the mind as an adaptive mechanism. But to the same end, and proceeding from the rapid advancement in physiological and physico-chemical experiment, a revolution of ideas has been wrought, of which an example is the final dislodgment of the ancient conception of an oppositeness of physical reactions of "integration and disintegration," through the later discoveries proving the protective relations between normal emotional and physiological reactions. In the normal field this strengthens the foundations for cooperation in the merging of the problems and methods of psychology and medical research.

In the abnormal field the special place of these laboratories may now be pointed out by briefly recapitulating the meaning of some of the main events here narrated. In conclusion it remains also, with respect to the notable influence of the Heidelberg school, to specify more particularly what its doctrines were with reference to the results of their contact with the purposes of the combined laboratories; the manner of their introduction has been described. The beginnings of modern psychiatry are ascribed to Griesinger, who, in the awakening of his time, recognized the deeper physiological truth which he failed to impart. In the order of nature and universal experience the contrasts of mental pleasure and pain have been associated with many of the implications of exaltation and depression. The alienists rested upon Griesinger's verbal formulations; these have served the purpose of describing "clinical types set up," and even tended to antagonize the

[11] A Study of the Relations between Certain Organic Processes and Consciousness. J. R. Angell and H. B. Thompson. *Psych. Rev.*, Vol. 6, 1899.

Organic Changes and Feelings. J. F. Shepard. *Am. Jour. Psych.*, Vol. 17, 1906.

Elements of Physiological Psychology, Chap. VII. Ladd and Woodworth. New Ed. 1911.

seeking for explanation through physiological principles with which, in fact, they do not fit.

The psychiatric movement has been substantially governed by the practical principles of the "supporting treatment"—the energy concept, under the influences of general medicine, which prompted the founding of the McLean laboratories, in their combination, and the change proposed in 1887 of the Griesinger formula to fit both the mental and physical facts. The inspiration to psycho-physical research then brought by Stanley Hall from the laboratories of Ludwig and Wundt, chiefly the former, did not change the physiological attitude; it was sought to escape from the domination of the ancient descriptive conceptions lacking explanations of the obvious changes of physical functions. When later the teachings of the Heidelberg school were brought in, they proved to revive the doubted formula; with some words of elaboration upon the model of the "three-dimension theory" the "triad of opposites" was framed and came into general use:

exaltation	excitement	flight of ideas
depression	retardation	difficulty of thinking

with differentials of "increase and decrease" and determinations of disease-forms by reaction-time experiments.

This position was essentially descriptive and exactly contrary to that of Griesinger and the original purpose of the laboratories. It had no leaning toward the proposed physiological and physico-chemical explanations; the four missions of inquiry to psychiatric centers in Europe, 1888-1901, found no prolonged measures established for such combined research, but rather a lack of hopeful views of it. The clinical field of the McLean laboratories became the scene of an attempt to harmonize the perpetuated descriptive attitude and the explanatory attitude. In the first years the former flourished more, but the latter persisted. In the later period of nearly 15 years of expert work in "pure chemistry" and "pure psychology" conjoined in the clinic there emerged another change of scene indicated by the quoted description of some of the work done. The earlier conventional methods of measurements by time factors were proved to be of limited usefulness. There was increasing recourse to physico-chemical investigations of nutrition and other problems, and to new collaboration in methods for "studying the problems of the whole man" immediately presented by the physical facts of the clinic.

In the greater experiment formed by the years of work of these laboratories the primary problem was held in the proposition that all the activities represented by behavior, whether

normal or abnormal, are always conditioned by the state of the energy potential, whether adequate or inadequate, modified or inhibited by interferences. The field of mental disorders is nature's laboratory, where the psychologist's methods of analysis must fit both the mental and physical problems of the psychiatrist. The energy concept being held as implying the storage of energy in living substance, and the law of physiological use as implying growth in functional power, these physical facts are extended by the new advances in the physiology of protective and defensive reactions. This new proof sustains for psychiatry the conception of the effects of overuse, waste in excess of repair, irritable weakness with lowering of thresholds, failing inhibition with increasing activity tending to losses through exhaustion by degrees of sensori-motor function to states of lethargy, and death. In the growing recognition of the constant presence of such elementary principles conceptions of a developmental or genetic character emerge for dealing with the complexes of abnormal mental and physical conditions. Thus there is revealed the broader field of explanation for the new psychiatry.

The dynamic principle long recognized in practice has prevailed in the work of these laboratories, although usage still clings to the old formulae, which do not fit the physical facts. Psychiatry, by laying broader foundations, is becoming more completely free to frame its creed with a new ritual upon the coming revelations of physiology.

NOTE.—In this account of the laboratories only brief reference could be made to the genesis and course of forces proceeding from psychology into psychiatry and their relations to the modern advancement in the medical sciences. Yet the leading purpose here is to indicate the causes and import of the general laboratory movement in the development of psychiatry; this being still in its early stages in the seeking for clearer theory to fit the facts underlying the great progress in psychiatric practice and to fix attention upon the chief interest, the account of the contributive work of these laboratories is kept, as nearly as possible, objective and impersonal. But the outcome of all prevision in such matters being dependent upon the responses of the individual workers, it is of interest to psychology to note how those brought into contact here with the interacting influences of the combined laboratories and clinic produced substantial proof of the soundness of the method for the mutual promotion of progress in all these special fields.

It is due to the laboratory workers to make further acknowledgment of their efficient zeal and their valued contributions responsive to the opportunity. These being aids to the clinical service, this remains the substantial and lasting basis of the whole work. A true estimate of this can not be made without a large measure of recognition of the essential value of the intelligent co-operation of those engaged in the clinical service. Acknowledgment of his im-

portant work in this service is due especially to Dr. Tuttle through his long service since 1879, and to Dr. Abbot since 1890 except a brief interval, to the present time. It ought not to be omitted here to note the salient facts of the progress in treatment and its concurrent influences in clarifying the related psychologic and psychiatric problems. From the beginning of this period of nearly forty years there was a continuance of the tendency to the lessening use of controlling drugs as adjuvants to the "supporting treatment" in which the alienists had been the leaders of the century. A summary of the marked progress in this regard was published in 1894.[12] Dr. Tuttle's continued contributions to this progress, through conservative, painstaking observation and disposition to prove all things in theory and practice, made so much practical advancement in the use of physiological therapeutics, both in the physical and mental fields, that he was able to make the following report in 1913: "No striking changes in methods of treatment. Emphasis is still laid on the superior advantages of out-of-door exercise, full feeding, and hydrotherapy for its tonic or soothing effects as against sedative and hypnotic drugs, which practically are never prescribed."

The methods of treatment described are an achievement as original and independent as any in practical therapeutics by the tests of experience,—a logical demonstration of cause and effect. They have an important bearing upon the validity of the psychological observations in the combined services as essential aids in the shaping of psychiatric progress by the exclusion of artificial interferences with the study of both psychopathological and associated normal adaptive reactions. Case histories in the literature concerning "disease-forms" are always open to question when the "medication" is not mentioned; the common omission of this detail of treatment suggests the possible and often probable sophistication of symptoms by drug-effects. It is significant of the coordinating influences in the combination of these services, toward the long desired overcoming of the barrier between mental physiology and mental pathology, that Dr. Abbot's "adaptive reaction" has been from his early work of a physician in the wards to the direction of the special clinical and pathological departments and to the attitude of a psychologist whose contributions are informed with thorough comprehension through a practical psychiatric training.

The interest to psychology of such an account as this is a very special one in the universal movement on all sides for the solving of the chiefest of all problems. To the master science the contributive work on the physical side is being mostly devoted to the study of the causative effects of organic diseases upon mental integrity; on the other hand there are extremes of the admirable zeal in the analysis of the thinking process tending to exclude attention to the physical facts, and promote the continued formal study of "clinical types set up,"—the progressive spirit working along lines bounded by traditional conceptions. The interest of the present situation to psychology is that when it turned to physical facts, physiology and psychophysics, it laid the sound foundation upon which the genetic method is building up impregnable constructive conceptions, this process being concurrent with the trend of the same forces in general medicine. After twenty years or more psychology had freed itself by experiment from the bondage of the ancient conceptions embodied in the "three di-

[12] Progress in the Care and Treatment of the Insane during the Half-Century. E. Cowles, *Am. Jour. Insanity*, 1894.

mension theory," as Angell and his students showed the conclusion to be. Yet psychiatry has continued, for almost another score of years, to "set up" the motive factor of feeling, which lies at the basis of adaptive reactions, in terms describing the true contrasts or "oppositeness" of the *qualities* of mental pleasure and pain but in words of double meanings falsely implying a like "oppositeness" of the physical facts. Griesinger and others knew better through the more fundamental energy concept, but that availed nothing; medical literature has come to be full of reliance upon it; but psychiatry, still unable to work out explanations through its misconceptions, turns away from the wealth of newly known facts in the physiological mechanism saying "the symptoms are all we have." Can the question be answered: Why continues this disjunction,—this resistance since Griesinger's time? Is it something inherent, atavistic? Our prehistoric forebears found comfort and safety in the trees,—they feared the prowling dangers of the earth beneath; they were cave dwellers in the cliffs, worshipped the sun in the high heavens and feared the dragons of the great abyss in the waters under the earth. Have we this disposition ingrained, solid—something that must stay, ever to be interred with our bones? The answer of psychology is that, under general principles that apply to a large class of the emotions, the motor reactions called forth as a part of the bodily resonance are adapted for the defense and preservation of the individual, and that the same or other reactions operate to the same end for the species; therefore evolutionary biology is justified in considering the bodily expressions of emotion as instinctive actions reminiscent of ancestral ways of life. (Ladd and Woodworth.)

Our inherited attitude toward life in its normal relations is set upon the instinctive conviction that we should seek pleasure and avoid pain, like ease and dislike labor, and recognize the protection of rest and the warnings of fatigue. Yet we subject ourselves to toil and pain for gaining future ease and the highest good, use our fears for defense and grow strong in the struggle for existence; we rejoice in overcoming. The psychologist, finding in this no confirmation of his former theory concerning the physical facts, may have little difficulty in adjusting his thinking to the play of the emotions on the normal plane where emotional feeling is secondary to the results of ideation and experience; he may content himself with introspection. But the physician finds his work on the pathological plane where the prevailing affective tone, both of morbid sadness and joy, proceeds from sources of real physical disorder and losses of the integrity of function. On the normal plane the emotional changes may be described intelligibly, though figuratively, as from low spirits to high spirits; both being normal they may vary alike with increase of intensity, activity, and force still under normal control. But the physician has to deal with pathological changes which always imply failure of functional integrity; the losses of control, which is the essential index of the energy content, are represented by the "irritable weakness" shown in the increase of activity in restlessness, sense of inadequacy, and consequent "mental pain;" then failure may continue through further declension of functional integrity shown in deeper sensory losses by the *fictitious* sense of well-being, with lessening control and more and weaker activity to complete loss.

It should be said that these observations, repeated in other words from foregoing pages, describe a type of cases that show such courses of reduction under stress as in Nature's experiments with normal

subjects,—such as hardy shipwrecked sailors and lost wanderers in the desert who decline through stages of despair, delirium, and exhaustion to dissolution. In the mass of cases there may be many individual variations as to which of the complex of functional factors goes first to annulment,—when there may be seeming or real stupor,—a partial or general retardation in some reflex reactions; but there is a remarkable uniformity in the essential elements of the clinical pictures, whether from regular reductions of the sustaining force or through interferences. Every psychiatrist knows the meaning of the "deeper levels of dissolution," and is governed by the principle in his practice. Here comes again the question of the resistance of psychiatry since Griesinger's time to the fundamental principle now long proven by experiment in psychology and physiology. Is it that the psychiatrist, who does not experiment, is so set in his ancestral, arborescent, cliff-dwelling, instinctive conceptions that he cannot reconstruct his ambiguous formulae to fit the facts he knows? Psychology and physiology have much to learn from psychiatry of the variations of physical facts that must condition mental activity; there should be somewhere a foundation upon which the present divergencies of psychology can come together; in its turn not the least of its duties is to persuade psychiatry to believe the meanings of the things it already knows; but much more is needed to fill the larger place that is waiting for true guidance of the master science in the preventive and curative work of the mental clinic.

Discontent with things as they are avails but little; this account is purposely limited to what has been done so far in the prolonged attempt to break the bondage of tradition and words. The first need in the present time of great promise is to set a true foundation upon which all research and psychoanalysis may build. The energy concept is most fundamental and must be reckoned with throughout; some constructive proposition is in order here,—to point the moral if not to adorn the tale. Under this conceptions the relations are shown of the essential elements of the melancholia-mania symptom groups; these are comprehended in four stages, or phases: (1) Neurasthenic, (2) Melancholic, (3) Manic, (4) Exhaustion, ending in dissolution. As there are no sharp "border lines" anywhere between the phases the expedient of "mixed phase" description must be applied alike to all of the variables of transition from one characteristic phase to another. In the typical course of lessening functional capacity the order of the condition changes can be best explained in terms of control. The losses of poise at the sensory and motor thresholds, in both the thinking and physical reactions, represent the reductions of physiological inhibition which is the index that varies directly with the energy content which may continue regularly to exhaustion and dissolution. This curve of inhibitory control consistently harmonizes, to the end, with the energy efficiency,—allowing for the variable interferences above explained. The activity, or "excitement" criterion is a false index; it varies inversely,—the more restlessness and excitement the more "irritable weakness." This metaphorically carries the graphic curves of "increase" to high and feeble levels on the *quantity* scale; thence they must drop through the whole scale of successively waning and exhausted areas of contributive action,—("the disease crosses the normal line" according to an eminent writer), in order to complete the representation of the terminal energy subsidence in retardation, stupor and death.

It should be said further that it is not meant in this account of the laboratory movement to minimize the great contributions of the Heidelberg studies to psychiatry. While the measurement of time factors appears to be of limited usefulness, with respect to the "three dimension theory" as in experimental psychology, yet the methods of case study and clinical analysis have been developed upon the true basis of the general principle of reflex action in the physiological mechanism. It is proved that these physical factors are not to be ignored, but that they furnish a guide to an orderly method for the introspection which helps to reveal not only the relations of the mental activities among themselves but also the controlling forces of the conditioning and always changing adaptations of the physiological reactions.

The conclusion that emerges may be restated here. Wundt, representative of the psychologists' attitude, formulated current conceptions in the proposition concerning the feeling-factors and sought proof for it in physiology, reaching the verdict not proven, but leading to great advancement through the precise study of physical facts. On the other hand the formulation of the energy concept was contemporary—even prior, in the practice of psychiatry. The inception of these laboratories started with this genetic principle, discarding early the physical import of the depression-exaltation formula. The validity of the energy concept, and the genetic principle as in general medicine, has been worked out in thirty years or more in these laboratories. Meantime the Wundtian theory reached a negative conclusion nearly twenty years ago. The moral of the whole matter has many specifications; among them it appears that psychology, on its part, having freed itself from the ancestral theory, has yet to apply the new knowledge of the real physical reactions that condition the expression, through the common path, of all the findings of the diverging specialists in psychology; they have yet to fit the facts that the psychiatrist knows. Psychiatry, on the other hand, finds in the pathological plane something more in the ancestral theory than its comparatively academic and negligible import for normal psychology; it has not adopted the correction that psychology and physiology have found. Having not yet freed itself from the bondage of metaphorical description, it still contents itself in its use of "forms of words" that have no physiological meaning, and block the interest in explanation. The growth in facile description and the practice of keen analysis of the mental activities (symptoms and behavior) are so satisfying that psychiatry stays superficially content with a verbal formula false in theory and fact. The force of this lingering error is surely though slowly waning before the soundness of the empirical methods and practice long wrought out. To hold the place that belongs to it psychiatry has its greatest opportunity in no longer neglecting the aid that all contributing sciences are striving to offer.

ON THE NUMBER OF ARTICLES OF PSYCHOLOGICAL INTEREST PUBLISHED IN THE DIFFERENT LANGUAGES

By SAMUEL W. FERNBERGER, Clark University

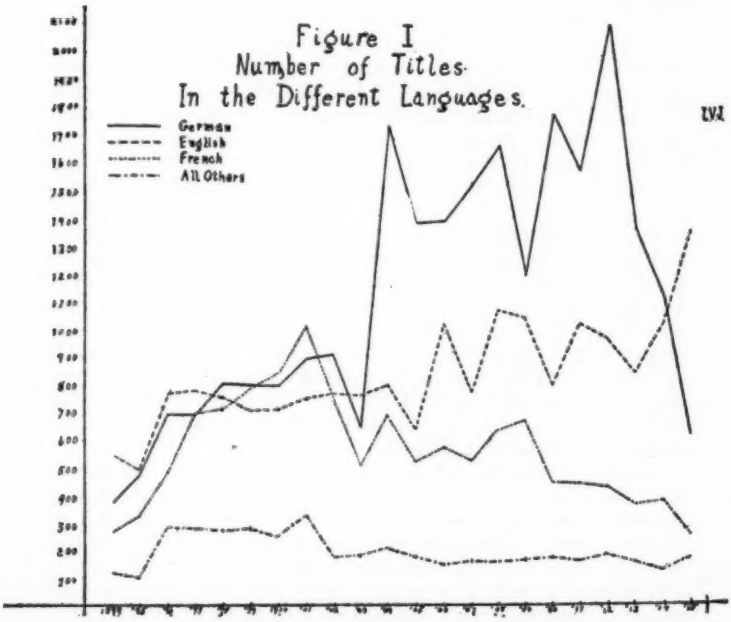
The *Psychological Index,* which has appeared annually for the past twenty-two years, is a bibliographical collection of publications which have appeared in psychology and cognate fields. There are included not only titles in the field of psychology proper, both theoretical and experimental, but also papers from related fields if they contain materials of psychological interest. Such fields as philosophy, education, anthropology, ethics, psychiatry, physiology and sociology are included. This compilation of titles is by far the most complete to be found. The editors have been in close coöperation with the *Bibliographie* published by the *Zeitschrift für Psychologie und Physiologie der Sinnesorgane* for the collection of German titles, with the *Année Psychologique* for the French titles, and with certain French and English individuals. This coöperation has been effective since the third year of publication with the exception of certain and infrequent lapses.

Hence we may believe that practically all of the articles in the field of psychology, or those of at least considerable psychological interest, may be found in these compilations. And it may be assumed that the total out-put listed from any given country may be accepted as an adequate measurement of the degree of psychological interest prevailing in that country. We do not wish to imply that the relative significance of each country's contribution to psychology can be determined from a mere perusal of the *Index;* this is obviously a matter in which total number of publications may play but a small part, but it seems possible that an indication of interest in psychological topics may be furnished by an appeal to mere number of papers published.

Several difficulties at once present themselves. If one is to determine the number of titles produced by each country in every year, one must determine the place of residence of every author. The solution of our problem did not seem to warrant such a great expenditure of labor, although such a determination would obviously have been the more correct method. To make such a determination, however, each author

must have been investigated because the language of the publication or the place of publication is by no means always an indication of the place of residence of the author.

The alternative scheme of classifying the titles with regard to the language in which they were written was adopted. Several drawbacks are apparent. For example, all German, Austrian and some Swiss titles had to be included under the general caption of German. French quite as obviously included the French articles proper, as well as Belgian, Swiss, some Italian and a few Russian. Italian was, of course, relatively pure. But the great trouble with this method of classification was that English and American titles could not be differentiated. Such a differentiation was not possible without investigating the place of residence of each author because the matter is complicated by the fact that a relatively large number of papers by English authors appear in the American journals, and also many of the large publishing firms bring out their books simultaneously in both Great Britain and



America. In our enumeration we found very few titles in any language except English, German, French and Italian. Hence we included all of the others under a single caption and in this group will be found titles appearing in the Scandinavian languages, Spanish, Dutch, Russian, Hungarian, Polish, Greek and Japanese.

TABLE I

NUMBER OF TITLES IN THE DIFFERENT LANGUAGES

Date	German	English	French	Italian	All Others	Total
1894	375	550	265	82	40	1312
1895	474	489	325	80	26	1394
1896	695	770	492	182	95	2234
1897	694	785	704	221	61	2465
1898	816	759	713	209	61	2558
1899	812	714	785	223	50	2584
1900	808	718	851	209	41	2627
1901	897	744	1015	278	51	2985
1902	923	771	759	147	28	2628
1903	661	767	513	164	17	2122
1904	1735	804	692	202	12	3445
1905	1380	651	523	160	13	2727
1906	1389	1026	584	140	6	3145
1907	1523	773	541	144	14	2995
1908	1664	1069	643	126	30	3532
1909	1195	1037	673	131	31	3067
1910	1767	800	450	151	18	3186
1911	1574	1022	445	116	45	3202
1912	2102	969	435	159	27	3692
1913	1364	853	363	123	37	2740
1914	1120	1016	383	88	35	2642
1915	619	1589	254	125	47	2634
Totals, 1894-1915	24587	18676	12408	3460	785	59916

The results of our counting will be found in Table I. In the first column will be found in order the dates of the twenty-two years covering the period of publication of the *Psychological Index* (1894-1915). In the next column will be found opposite each date the number of German titles which have appeared during that year. In the successive columns will be found opposite each date the number of titles which have appeared during the year in English, in French, in Italian, and in all of the other languages. Finally, in the last column will be found the total number of titles which appeared in all languages for each year. The bottom row of this table contains the total number of titles published in each language

during the entire period of twenty-two years. Figure I represents the same results thrown into the form of curves. Along the abscissa, the different years of publication have been laid off in order; while the number of titles have been erected as ordinates. Only four curves are represented,—those for the German, English and French titles in separate curves. For the sake of simplicity, we have here grouped the Italian titles with our group of 'All Others.' Hence the fourth curve represents the combined results of the fifth and sixth columns of our tables.

An examination of these curves and of the values which they represent proves to be of considerable interest. Let us first consider the general form of each curve separately and then turn to a discussion of the relations between the different curves.

The curve for the number of German titles starts with low values (375 in 1894); but after two years there is a very marked rise (695 in 1896). This marked rise is probably due to the fact that this year marks the beginning of the coöperation between the *Index* and the *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*. We believe that the German periodicals and publications were not adequately represented during the first two years of the publication of the *Index*. But now, with the coöperation with the *Zeitschrift*, we may expect an adequate representation of the German titles inasmuch as they are collected in the home country. This coeditorship of the *Zeitschrift* and the *Index* continued for six years, and during this time the curve shows a relatively rapid and fairly steady increase in the number of titles,—reaching a temporary maximum of 897 titles in 1901. During the next two years there was apparently a temporary lapse in the relations of the *Index* and the *Zeitschrift*. Probably due to the inadequacy of the gathering of the German material during these years, the number of titles drops in 1903 to 661. It seems reasonable to suppose that this is the cause inasmuch as in the next year (1904) when relations with the *Zeitschrift* are resumed, the number of titles in the German language suddenly rises to 1735. It is very probable that this maximum, which was never surpassed until 1910 and has only been surpassed twice (1910 and 1912), is a false maximum. By this we mean that there are included in this year titles which actually should have appeared in the *Index* of the previous year. Also it is possible that this year may have been one of great production at the expense of the years before and after,—that is, many books may have appeared

early in 1904 which should have appeared late in 1903 but were held up for some reason, and similarly, many books may have appeared late in 1904 which, in the ordinary course of events, should have been brought out early in 1905. We can certainly say that the German production of 1903 and 1905 was considerably less than that for 1904.

For the eight years, 1904 to 1911 inclusive, the German production remained fairly steadily close to this high maximum. The one obvious exception is the drop in 1909 to 1195 titles, for which we are unable to give any explanation. In 1912 the number of German titles of psychological interest reaches the surprising maximum of 2102,—a number greater by 350 than has ever been attained by any other language for any year. Inasmuch as the number of German titles for 1911 and 1913 are each considerably smaller than that for 1912, we believe that this exceedingly large number is again a false maximum. From 1912 on, the curve for the number of German titles takes a surprisingly marked and rapid drop. Starting in 1912 with 2102 titles published in the German language, we find 1364 in 1913, 1120 in 1914, and only 619 in 1915. The rapid fall of the last two years is undoubtedly due to the effects of the present war. During this last year (1915) the Editor of the *Index* himself expresses the doubt that he has been able to collect all of the German titles; but during 1914 the *Index* was still brought out in coöperation with the *Zeitschrift* and so the list for this year should be relatively complete. And for this year just a little more than half as many titles are listed as were recorded two years previously.

Turning now to a consideration of the curve for the number of English titles, we find that it is very different as regards general form. It will be remembered that this curve includes both English and American productions. This curve also starts with low values for the first two years and then takes a rather rapid rise. Inasmuch as all of the four curves take a rapid rise for the third year, we believe that we may consider that this is due to greater completeness in the work of the bibliographers after the first two years of publication. For a period of nine years (1896 to 1904 inclusive) the curve of the number of titles in the English language remains surprisingly constant between 700 and 800 titles. The next year (1905) the number drops to 651 items. From now on the curve has an irregular but slowly ascending course for the ten years (1905 to 1914 inclusive),—reaching a maximum, for this period, of 1069 titles in 1908. For last year (1915) the curve has taken a remarkable upward course, reaching the

surprising maximum of 1589 titles. This is over 500 more titles than has ever appeared before in English for any one year; and this total has only four times been exceeded by the German curve. This is probably *not* a false maximum because the number of English titles for 1914 is well above the average for the last few years. We believe that this marked increase is due largely to the greater out-put of psychological literature in America. We have carefully separated the American from the British titles for 1915 with the following result. Out of the total of 1589 titles appearing in the English language for that year 1063 or 66.90 per cent were of American origin, while only 526 or 33.10 per cent were of British origin.

The curve for the French titles has again a very different form from either of those which we have discussed. It will be remembered that most of the Belgian and some Swiss titles are included under this heading. This curve starts also with low values and for the first eight years it shows a perfectly steady, although by no means regular, increase. In 1894 this curve starts with a value of 265 titles and by 1901 has the surprising total of 1015 items. For the next two years (1902 and 1903) the curve shows a marked drop,—reaching a temporary minimum in the latter year of 513 titles. For the next six years (1904 to 1909 inclusive) the curve is relatively irregular but remains approximately on a level of 600 titles. The last six years (1910 to 1915 inclusive) have seen a tremendous and almost regular decrease in the number of French titles,—reaching an absolute minimum in 1915 of 254 titles, or 11 less than were recorded in the first publication of the *Index* twenty-two years before. The decrease is very marked for the last year and is undoubtedly due to the effect of the war and the utter suspension of all scientific work in Belgium and the north of France. The editor of the *Index* for 1915 speaks of the coöperation of the French correspondents, so we may believe that the list of French titles is relatively complete.

The curve of the number of titles for all languages other than German, English and French need not detain us for very long. This curve is composed largely of Italian titles as a glance at Table I will indicate, although from time to time a number of Russian and recently a number of Scandinavian articles has swelled the totals in the column with the caption 'All Others.' This curve has a course almost similar to that for the French titles except that the variations are not so marked. It starts with low values and more or less steadily

increases to a maximum of 329 items in 1901, in which total the large number of Italian titles for that year is chiefly responsible. The next year shows a considerable drop, and from then on the curve is surprisingly regular although it shows a very slight tendency to decrease. There does not seem to be any apparent effect of the war on the number of titles for the last two years.

Let us now consider the relative courses of the various curves. That for the Italian and 'other' titles is so much lower than the other three curves that we may eliminate it from our discussion. Our discussion of the relative heights of the three curves will therefore be based on a consideration only of those for the German, English and French titles. For the first ten years of the period covered by the publication of the *Index*, the curves representing the number of titles listed yearly in the three languages under consideration, are of approximately the same height and are of the same general form. The curves cross one another frequently. Five times during this period of ten years there were a greater number of English titles than of either German or French; twice English stood in second place and three times in third. During this period German stood three times in first place, six times in second and once in third. French stood twice in first place, twice in second place, and six times in third place.

For the period covered by the next ten years (1904 to 1913 inclusive) the relations are very much changed. During this period the curves draw gradually farther and farther apart. In 1904 the number of German titles had an enormous increase,—a fact which we believe, as pointed out above, is due to the closer coöperation of the *Index* with the *Zeitschrift* on the one hand, and on the other, to the fact that the total for that year reaches a false maximum. But the German curve retains its relatively high values and is only once (1909) even approximately approached by the curve for the English titles. The French curve for this period takes an exactly opposite course and decreases considerably and fairly regularly during these years. The curve for the English titles takes the middle course,—it is irregular but has a general tendency to increase, although never markedly.

For the period of the last two years (1914 and 1915), however,—the period covered by the present war,—the relations are very different. The curve for the French titles still shows a marked tendency to decrease. The curve for the German titles also shows a marked downward tendency, which for this last year may possibly be due in part to the difficulty

of obtaining the titles from abroad. The English curve, on the other hand, shows a marked upward tendency, especially marked in the last year. Hence, in 1914 the German and English curves had come very close together,—the Germans holding the supremacy, but only by a little more than 100 titles. For the last year, however, these two curves have crossed very markedly and in the 1915 number of the *Index*, the English titles held the supremacy over the German by nearly 900 items.

TABLE II

PERCENTAGE OF TITLES IN THE DIFFERENT LANGUAGES

Date	German	English	French	Italian	All Others
1894	28.58	41.92	20.20	6.25	3.05
1895	34.00	35.08	23.31	5.74	1.87
1896	31.11	34.47	22.02	8.15	4.25
1897	28.15	31.85	28.56	8.97	2.47
1898	31.90	29.67	27.87	8.17	2.39
1899	31.42	27.63	30.38	8.63	1.94
1900	30.75	27.33	32.40	7.96	1.56
1901	30.05	24.92	34.00	9.31	1.71
1902	35.12	29.34	28.88	5.59	1.07
1903	31.15	36.15	24.18	7.73	0.79
1904	50.45	23.34	20.09	5.86	0.26
1905	50.61	23.87	19.18	5.87	0.47
1906	44.17	32.62	18.57	4.45	0.18
1907	50.82	25.79	18.05	4.87	0.46
1908	47.11	30.26	18.20	3.57	0.86
1909	38.96	33.81	21.94	4.27	1.01
1910	55.46	25.11	14.12	4.74	0.57
1911	49.16	31.92	13.90	3.62	1.40
1912	56.93	26.24	11.78	4.31	0.73
1913	49.78	31.13	13.25	4.49	1.35
1914	42.39	38.46	14.50	3.33	1.33
1915	23.50	60.33	9.64	4.75	1.78
Average, 1894-1915	39.62	31.87	21.14	5.94	1.43

It is of interest, we believe, to consider the percentage of titles published each year in the different languages. These results will be found in Table II which is compiled under captions similar to those employed in our first table. The last row of this table contains the average percentages for each language of the entire period covered by the publication of the *Index*. This percentage table is of interest because the *total* number of titles listed varies from year to year and so the relative proportions are perhaps more obvious than

those obtained from the simple distribution table. Again we may disregard in our discussion all consideration of the percentages of Italian and 'All Other' titles because they never seriously affect the general relations for the other three languages. For the period of the first ten years, however (1894 to 1903 inclusive), these titles had to be reckoned with, as they were frequently more than 10 per cent of the entire number listed.

For the period of the first ten years we find that the German, English and French languages each accounts for about 30 per cent of the total listing. Then from 1904 to 1913,—the period of German supremacy,—the German titles account for nearly 50 per cent of the items. In the year 1912 the German percentage rose to 56.93. During this period of ten years the average percentage of the German titles was 49.34. During the same period the percentage of English titles remained fairly constant,—more or less in the neighborhood of 30 per cent. The percentage of French titles for this period dropped rather steadily, being on the average a little less than 17 per cent.

When one adds the percentages for the German and English titles for the last twelve years one is astounded by the supremacy of the two languages. And we believe that number of titles in any language is a rough indication of the interest in this field by the peoples writing in that language. The average combined percentages of the German and English titles for this period (1904 to 1915 inclusive) amounts to 78.44 per cent. It is difficult to realize that nearly four of every five titles of psychological interest that have appeared in the last twelve years, has been written in either the English or German languages. The combined percentage for any year during this period has never fallen below 72.77 (1909). The highest combined percentage occurred last year (1915) when 83.83 was reached, but this was very closely approximated in 1912 with a combined percentage of 83.17.

For the sake of completeness let us compute certain totals and general averages for the entire period of twenty-two years covering the publication of the *Psychological Index*. During this entire period there are listed in all languages 59,916 titles which are of psychological interest. Of these 24,587 or 39.62 per cent were written in the German language. In all some 18,676 English titles appeared, which account for 31.87 per cent of the total. French titles number 12,408 or 21.14 per cent. The number of Italian titles for this period is very much smaller than any of the other three languages men-

tioned, being 3,460 or 5.94 per cent. All of the other languages except these four only account for 785 titles or 1.43 per cent of the total number during the period of twenty-two years.

We believe that this study, crude as it may be, points definitely to the ascendency of psychological interest among the English-speaking peoples. Even though the small number of German titles for the last year be attributed to the difficulty of importing materials, still these are all that the American student can utilize at the present time. Also the absolute number of titles written in English has steadily increased during the years of the publication of the *Index,* and this increase has been very marked indeed during the last year when the number of titles for all other languages decreased very markedly. There is also a very noticeable decline of interest in matters psychological among the French-speaking peoples. This is true from an absolute standpoint and even more markedly from the relative point of view. Perhaps the most striking point brought out by this study is the extreme necessity for the student of psychology,—no matter of what nationality he may be,—to have a facile and critical reading knowledge of both German and English.

MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF VASSAR COLLEGE

XXXI. A Study of Freshmen

By Sophie D. White, Sybil May, and M. F. Washburn

The class of 1918 at Vassar College was in its freshman year made the subject of certain psychological investigations. The data collected with regard to its members were derived from four sources: (1) the answers to a questionary, (2) the results of tests, (3) the marks given on the academic work of the freshman year, and (4) reports of certain students as especially 'promising,' made by members of the instructing staff to the president at his request. Each of these sources is subject to errors. The questionary answers are more or less trustworthy according to the interest of the student in answering the questions, and to her skill in introspection. The test results are affected by the interest of the student in the tests, her physiological condition at the time of testing, and an individual characteristic, distinct from the ability tested, which we may call 'ability to be tested,' the capacity to meet promptly a sudden demand for the exertion of one's powers. The marks are influenced by the preparation of the student for college, her physical condition, her interest in her work, and the personal equation of the instructor. The reports to the president were affected by the personal equation of the instructor and the interpretation put upon the rather vague term 'promise.'

The questionary was sent to all members of the class within the first two weeks of the college term. It was prefaced by the following statement: "The questions should be answered only in so far as it is possible to do so with a reasonable amount of thought: answers should not be invented for the sake of saying something. A blank may be left after any question which seems unanswerable in a given case. No marks or grades of any sort will be given to the answers, and no public use will ever be made of names."

The following questions bore on individual differences in imagery: "Can you readily remember what you hear, in a lecture for instance, or do you imperatively need to see a thing in print in order to remember it?" "Can you picture geometrical figures readily in your mind?" "Do you remember music well?" "Is the pronunciation of a foreign language especially hard for you to acquire?" "Do you have difficulty in scanning Latin and other verse?"

The following questions on 'interest' were asked: "What subjects of study do you find most interesting?" "What subjects of study do you find most uninteresting?" "Are you interested in working with your hands?" "Do you like laboratory work?" "Do you greatly enjoy poetry?"

The following questions related to endowment in language facility: "Do you remember the words of a passage readily, or the thought only?" "Do words come to you readily or with especial difficulty in an oral recitation?" "Do you like to write?"

The following questions referred to differences in the readiness with which attention is adapted to a given task, and the strength of 'de-

termining tendencies': "When out walking alone, is your attention usually more occupied with your surroundings or with your thoughts?" "Is it easy for you to turn from one task to another, or do you become so absorbed in one task that you cannot readily drop it?" "Do you work best in the morning or in the evening?" "Must you be absolutely alone in order to work effectively?" "Do you habitually plan the work of a day beforehand?" "Do you habitually carry out your plans, or do you often fail to finish your work when not compelled to do so?"

These topics were chosen because they represent individual differences readily accessible to untrained introspection, and not likely to be taken as a joke by the irreverent undergraduate, as subjects bearing directly on social and affective characteristics might have been. The endeavor was also made to frame the questions so that they could really be answered.

Two hundred and eighty-six replies to the questionary were received. With regard to the interests of the students in the subjects studied before entrance to college, the following facts appeared from these replies. (1) The ratio of the number of students who mentioned a certain subject as especially interesting, to the number who mentioned the same subject as especially uninteresting was, for history, 6.6; for English, 3.5; for modern languages, 2.9; for science, 2.6; for Latin, .76; for mathematics, .65. The interests of these incoming freshman girls thus appear to be least marked for Latin and mathematics. most marked for history and English. (2) When the number who thought a given subject especially interesting is added to the number who thought it especially uninteresting, we get a measure of the strength of the affective reaction to that subject: if the number is small, the students tend to regard the subject with indifference, being neither greatly interested nor greatly bored by it. Science has to be left out of this calculation, as not all the students offered it for entrance. Latin is regarded with the greatest indifference, the total number of extreme reactions to it being only 150; history comes next, with 161, modern language next, with 172; English next, with 196, and mathematics stands at the top, with 218; a high number which as the figures under (1) show is due to the number of persons who strongly dislike it.

Correlations by the presence and absence method were calculated for the answers to a number of the other questions.

(1) A slight negative correlation (—.21) appeared between interest in mathematics and fondness for writing. The results showed that the chances are nearly even (46%) that a student in this group who dislikes to write will like mathematics; while they are only 1-3 (34%) that a student who likes to write will like mathematics. A moderate incompatibility between mathematical and literary expression is thus indicated.

(2) A slight negative correlation, obtained also between enjoyment of poetry and fondness for manual work (—.18). Of those who enjoy poetry, only 24% like manual work; of those who dislike poetry, 81% like manual work.

(3) A still smaller negative correlation (—.16) is shown between interest in science and attention to one's own thoughts rather than to the surroundings: thus of those who are not in the habit of observing their surroundings, 24% are specially interested in science, while of those who are habitually interested in their surroundings 31% are interested in science. These percentages are affected by

the fact that not all the students had had an opportunity of studying science.

(4) The highest positive correlation, one really significant, obtained between the claim to accurate verbal memory and the possession of oral fluency in recitation. It was .41. Of the students who say they readily remember the exact words of a passage, 71% say that words come readily to them in recitation: of the students who say they cannot remember the exact words of a passage, only 42% state that words come readily to them in recitation. Of the students who say words come readily, 37% claim accurate verbal memory; of those who say words come with difficulty, only 20% claim accurate verbal memory. This is a fact that points towards the existence of specialized verbal ability.

(5) A small positive correlation, .20, is shown between ability to shift attention readily and preference for the morning as a period of work. The majority of the observers said they could readily shift attention, and that they were morning workers. Of those who shift attention readily, 75% are morning workers; of those who do not, 66% are morning workers; of the morning workers, 79% have readily shifted attention; of the evening workers, 72% have readily shifted attention. These figures lend a little support to the idea that an evening worker is a person who takes a long time to adapt himself to work. It should be borne in mind that the experiments of Gates[1] indicate that the difference between morning and evening workers is one merely of habit.

The tests were the following: a test of verbal memory and memory for ideas by the use of the "Cicero" passage (Whipple's Manual of Physical and Mental Tests, volume II, page 209), read aloud to the observer; the Reading Backwards Test, with the passage about the Indians (Whipple, I, page 334), the Hard Directions Test (Woodworth and Wells); the Analogies Test (Woodworth and Wells); the Sentence Building Test, with the words "cup, fraction, money" (Whipple, II, page 261), and the reasoning test, about the man swimming in the river, used by Mrs. Woolley in her "Mental Traits of Sex." The results of this last test had to be discarded because we failed to get enough light on the method by which the various individuals solved the problem: it is easy to guess the correct answer. A source of error was involved in the testing, in that there were about thirty different testers, all advanced students of psychology. To reduce as far as possible the variations due to the individuality of the tester, all the testing was done in the laboratory, and the only instructions given to the freshmen were read to them from statements previously distated and made absolutely uniform.

(1) The numerical results of the tests were as follows:

(a) Verbal memory, average number of words, 34.1. Highest score, 81; lowest, 6.

(b) Memory for ideas, average number of ideas, 23. Highest score, 51; lowest, 6.

(c) Reading Backwards Test, average time, 410.6 seconds. Highest score, 126 seconds; lowest, 890 seconds.

(d) Analogies Test: average time for first list, 89.5 seconds; shortest time, 27 seconds; longest time, 285 seconds; average time for second list, 80 seconds; shortest time, 22 seconds, longest, 180 seconds.

[1] Gates, A. I.: Variations in Efficiency During the Day. Univ. of Cal. Publications in Psychology, Vol. 2, No. 1, 1916.

(e) Hard Directions Test: average time, 153 seconds; shortest time, 38 seconds; longest time, 550 seconds.

(f) Sentence Building Test: average number of sentences, 5.5; average number of words per sentence, 15.6.

We undertook to correlate the test results with the class records of the students, by the following method. The system of marking at Vassar recognizes three grades only above passing; A, excellent; B, good; C, passing. The number of credit hours required for the successful completion of the freshman year is 30. In our calculation, each A on a student's record in the office was counted as 3; that is, if she received A in a three-hour course we counted 9 digits to her credit. Each B was reckoned as 2, and each C as 1; D's, or failures, were counted as minus 1's. By adding these numerical credits we obtained for each student a number representing her class-room work according to the instructors' judgments: these numbers ranged from 90, for a student who obtained a grade of A in all her 30 hours, to 30, or below in the case of students who failed in certain subjects. The distribution of the values thus obtained, however, was not such that indexes of correlation between them and the test performances could be found, for as a rule there were a number of students whose class performances were represented by the same number. We therefore selected, in the case of each test, the names of the students who stood in the first quarter and the last quarter when the results for that test were arranged in order, and calculated the average class standing of these two groups. If there was a marked difference between the average class standing of the first 25% of observers in a certain test and that of the last 25% of observers, we might conclude that positive correlation existed between excellence of class-room work and the ability tested. The average class-room standing of the entire class was 51.1.

For verbal memory, the average standing of the first 25% was 63.
For verbal memory, the average standing of the last 25% was 39.
The difference was 24.

For memory for ideas, the average standing of the first 25% was 62.
For memory for ideas, the average standing of the last 25% was 44.
The difference was 18.

For the Reading Backwards Test (speed of verbal perception), the average class standing of the first 25% was 63.
The average class standing of the last 25% was 44.
The difference was 19.

These three tests furnished the highest degree of correlation with the class-room performance of the observers. For sentence building (here the observers were ranked by the product of the number of sentences written and the number of words per sentence), the average class standing of the first 25% was 53.8. The average class standing of the last 25% was 41.8. The difference was 12. For the analogies test (average of both series), the average standing of the first 25% was 56.5; that of the last 25% 45.9; the difference was 10.6.

The Hard Directions Test correlated most poorly with class standing. For the first 25%, the average standing was 56.3; for the last 25% the average standing is 49. It appears that being slow at the Hard Directions Test does not imply academic performance noticeably below the average. It will be recalled that Meumann[2] distinguishes between an executive and a scholarly type of mind, according as one is able quickly to shift one's *Aufgabe* or is held by a persistent

[2] Intelligenz und Wille, S. 21.

Aufgabe: the scholarly type of mind might be expected to be slow in the Hard Directions Test, which demands rapid shift of attention and problem.

As an index of the presence of the kind of mental ability likely to produce high marks, the results of several tests taken together are most significant. There were eleven students who fell in the last quarter in three or more tests. Of these none quite reached average class standing (51.1): the rankings were 50, 50, 43, 45, 36, 33, 27, 24, 24, 21, 18. Of seven students who were in the last quarter in two tests, none reached average class standing.

There were seven students who were in the first quarter in four tests. One of these, whom we will call T., had only an average class standing: the standings of the others were 63, 66, 75, 87, 90, 90.

There were eight students who were in the first quarter in three tests. One of these (M.), had a class standing slightly below the average, namely, 48; one (W.) was just average; the standings of the others were 60, 75, 75, 78, 81, 84.

Thus it appears that excellent performance in several tests usually goes with excellent performance throughout the work of the freshman year; while very poor performance in several tests is correlated with a performance below the average in the work of the freshman year.

We obtained, finally, some interesting data connecting the test results with the commendation of certain students as especially 'promising' by their instructors. There were 88 students thus commended. Of these not one was found in the lowest quarter of excellence in more than one test. On the other hand, of the seven students who stood in the first quarter in four tests, every one was commended for promise, including the one (T.) whose class standing was only average. Of the eight students who were in the first quarter in three tests, six were commended for promise, including one (W.) whose class standing was only average.

XXXII. Directed Recall of Pleasant and Unpleasant Experiences

By Mildred F. Baxter, Koto Yamada, and M. F. Washburn

The motive which led the senior author of this study to devise its method was the desire to explore possibilities of testing the temperamental characteristics of individuals. As might be expected from the great difficulty attending such investigations, the most definite results of the study relate not to individual psychology but to general psychology. However, we do not feel wholly discouraged with the results from the point of view of individual psychology.

Briefly, we wanted to see whether we could get anything like a test of the 'optimistic' or 'pessimistic' tendencies of individuals from the readiness with which, under definite instructions to do so, they recall pleasant and unpleasant personal experiences. The method was as follows.

The observer was first put through a practice series in ordinary free associations, the first thirty words of the Kent-Rosanoff series being used as stimulus words. The association times were taken with a stop-watch. Then the following instructions were given: "I shall now give you two other series of stimulus words. To the first

set you are to respond by rapping on the table as soon as the word has suggested an unpleasant personal experience which you have actually had in connection with the thing signified by the word. For the second series you are to respond in a similar way when the word has suggested a pleasant personal experience. If you fail to recall such experiences within fifteen seconds I shall give you the next stimulus word. I shall give you five words from the first series, then five from the second, then five from the first, and so on in alternation. Before changing from one series to another I shall give you the signal 'pleasant' or 'unpleasant.'" The reaction times were taken with a stop-watch. After each response, the question was asked, "Was the unpleasantness (or pleasantness) you thought of physical or mental?" The stimulus words used were sixty more from the Kent-Rosanoff series, thirty each for the pleasant and unpleasant recalls. In order to eliminate the possibility that one set of thirty might naturally have more pleasant or unpleasant suggestions than the other set, we used each set for the pleasant reactions with one-half the observers, and for the unpleasant reactions with the other half.

The average reaction time for the pleasant experiences in the case of a given observer was divided by her average reaction time for the unpleasant experiences. There were sixty-nine observers, young women college students. Nineteen of these gave average reaction times which were shorter for the unpleasant recalls than for the pleasant recalls. In eleven of these cases the ratio of the pleasant reaction time to the unpleasant reaction time rose above 1.2. For thirteen of the fifty observers whose average time for recalling pleasant experiences was shorter than their average time for recalling unpleasant experiences, the ratio was .75 or below. Did the former group contain the most "pessimistic" observers of our collection, and the latter group the most "optimistic?" Would a person in a gloomy mood or of a pessimistic temperament recall unpleasant experiences more quickly than a person in a cheerful mood or of an optimistic temperament? James's principle of "emotional congruity" as a determinant of association will be recalled in this connection. It might be suggested that a person in a gloomy frame of mind would have his reaction time to unpleasant recollections lengthened by the emotional disturbance they would occasion. In our experiments, single very long reaction times, such as might be regarded as complex indicators, were omitted in reckoning averages.

We selected, for each of the observers who gave a ratio of .75 or less for the average 'pleasant' reaction time divided by the average 'unpleasant' time, three persons who were well acquainted with her personal traits, and were uninformed as to the purpose of our investigation: these persons were asked, "Do you think that A. (the observer in question) tends in general to be optimistic and cheerful, or pessimistic and uncheerful?" Similar inquiries were made for each of the observers who gave a ratio of 1.2 or more. If quick recall of unpleasant ideas indicates a pessimistic temperament, then the former group were the cheerful observers, the latter group the pessimists. Twenty of the friends of the former group judged them to be temperamentally cheerful; thirteen judged them to be temperamentally uncheerful; a ratio of 1.5. Nineteen of the friends of the latter group judged them to be temperamentally cheerful; eighteen judged them to be temperamentally uncheerful; a ratio of 1.05. Thus the testimony of friends offers some confirmation of the idea that there is a positive correlation between a cheerful temperament and especially

slow recall of unpleasant ideas. Obviously the method needs further development.

More definite results appear which bear on general rather than individual psychology. In the first place, it is evident that for the majority of the observers (72%) the average time for recalling unpleasant experiences is at least slightly longer than that for recalling pleasant experiences. The difference in time is very slight, however: the average reaction time for pleasant recalls is 3.05, with a m.v. of .24; the average reaction time for unpleasant recalls is 3.35 m.v. 19. That recall of pleasant experiences occurs more readily than recall of unpleasant experiences is further indicated by the number of zero cases, or cases where the observer failed in fifteen seconds to associate any pleasant or unpleasant experience with the stimulus word. The total number of zero cases for the recall of unpleasant experiences was 144; for the recall of pleasant experiences it was only 90.

Further, a rather curious relation appeared when we reckoned the total number of cases where the pleasant or unpleasant experience recalled was reported as physical and the total number where it was reported as mental. Obviously much inexactness in the use of these terms was to be expected of our observers. The number of pleasant experiences recalled where the pleasantness was classed by the observer as mental was 733; in only 647 cases was the pleasantness classed as physical. The number of cases where the unpleasant experience recalled was classed as mentally unpleasant was only 649; the number of cases where it was classed as physically unpleasant was 734. Thus physical unpleasantness would seem to be more readily recalled than mental unpleasantness, and mental pleasantness more readily recalled than physical pleasantness. The greater readiness to recall physical rather than mental unpleasantness might be due to the fact that mental unpleasantnesses are apt to be involved with complexes and hence tend to be suppressed; quite possibly also to the fact that physical unpleasantness (usually pain) is more homogeneous than mental unpleasantness and hence easier to recall. This suggestion was made by Professor Colvin during a discussion of these results before the Columbia Psychological Club. It is hard to explain why the pleasantnesses recalled should be so much oftener mental than physical. Possibly the fact is due to a tendency to avoid recognizing that one's pleasures are physical; the habit or convention of regarding physical pleasures as unworthy and undignified.

XXXIII. Accuracy of Visual Memory and Speed of Verbal Perception in Poor Spellers

By Annette Howell, Lucile Hopson and M. F. Washburn.

The English Department of Vassar College has the custom of selecting each year a group of conspicuously bad spellers from among its students, and subjecting them to special training in spelling. It occurred to us that an opportunity was thereby offered to the Department of Psychology for an investigation of the psychological characteristics of this selected group. We have to present in the following paper the results of certain tests made upon forty-eight notably poor spellers and an equal number of good spellers. The good spellers were selected simply on their own testimony; but bad spelling seems

to be so fashionable a weakness nowadays that people are in general willing to admit the fact that they are subject to it. It seems probable that a person who declares himself a good speller really is at least fairly good, since no social opprobrium attaches to the bad speller.

Everyone who has considered the problem presented by the constitutionally poor speller has weighed the possibility that such persons may be poor visualizers. Two of our tests were accordingly directed towards finding how our groups compared in the matter of visual memory. We first gave our observers tests of visual-verbal and auditory-verbal memory. Two passages of prose approximately equally difficult were presented: one was read aloud twice, and at the end of the second reading the observer was asked to reproduce the passage as far as possible in the original words: the other was read through silently twice by the observer herself and reproduced as far as possible in the original words. Each of the passages was used with half the observers for auditory presentation, and with the other half for visual presentation. The percentage of words correctly reproduced by each observer for each of the two passages was found.

Since in learning verbal material that is visually presented the words may be translated into auditory-motor processes, it seemed advisable to add a test of visual memory for material that could not be thus translated. Accordingly we presented to our observers a series of ten cards on each of which four nonsense figures were drawn in red ink. The figures were composed of straight lines, usually eight lines to a figure.

Each card was shown to the observer for ten seconds, and at the end of this time she was required to draw as much as she could of the figures on the card. The experiment thus tested the accuracy of the visual memory after-image, which was represented by the percentage of lines correctly recalled. Little if any verbal imagery accompanied these reproductions, but reports on its presence were called for.

It occurred to us, also, that one of the conditions affecting ability to spell might be that capacity for quick and accurate visual perception of words which is measured in the "Reading Backwards Test." Accordingly all our observers were subjected to this test, using the material supplied by Stoelting.

The results of the various tests were as follows. In the test of auditory-verbal memory, the average percentage of words recalled was, for the good spellers, 50.3, with a mean variation of 11; for the bad spellers it was 46.6, m.v. 10.4. In the test of visual-verbal memory, the average for the good spellers was 39.4; m.v. 9; for the bad spellers 37.4, m.v. 10.2. In the test with visual non-verbal material (nonsense figures), the average per cent of lines correctly recalled was, for the good spellers, 40, m.v. 9.3; for the bad spellers 27.5, m.v. 8. In the reading backwards test the average time for the good spellers was 318 seconds, with a mean variation of 89; for the bad spellers it was 493.8 seconds, with a mean variation of 139.

It thus appears that the good spellers have as a group decidedly more accurate visual memory after-images of material that cannot be translated from visual into auditory-motor terms; and that they are as a group markedly superior in the speed with which words visually presented can be associated with auditory-motor processes. That these differences are not due to differences in the general ability of the two groups of observers is indicated by the fact that the groups are nearly equal in memory for verbal material, that is, material which can be learned in either visual or auditory-motor terms.

BOOK NOTES

Proceedings of the American Society for Psychical Research. Vol. IX, Part 1, 700 p.; Vol. X, Part 1, p. 701-1332; Vol. XI, 1024 p. New York, Am. Soc. for Psych. Research, 1915-1917.

These three ponderous volumes appear to be all studies of the same persin. The first volume embodies the study of W. F. Prince, Ph. D. The second volume continues his study, ending with the twelfth chapter on the records of automatic writing. In the third and largest volume (dated August, 1917) Dr. Hyslop writes two long chapters, one introductory and the other on the examination of hypotheses, detailed record, etc. Beginning with page 867 Dr. Hyslop discusses another case, the Patison case. An extremely elaborate index is appended.

An elementary laboratory course in psychology. By HERBERT SIDNEY LANGFELD and FLOYD HENRY ALLPORT. Boston, Houghton Mifflin Co. (c. 1916). 147 p.

The authors here aim to describe the experiments in such a manner that students who have had only an introductory course in psychology can perform them without further assistance, in a half course of five hours a week, with simple instruments. In general they should be performed by the entire class in one room; they must not be too hard, must present the essential features in method and important facts, and it should be possible to get clear-cut results capable of interpretation by the students, and the experiments should not be too fatiguing.

Understanding Germany. By MAX EASTMAN. New York, Mitchell Kennerley, 1916. 169 p.

Part I discusses the anti-German hate, the characterizing nations, Nietzsche, something to hate; Part II, the only way to end war, what is patriotism and what shall we do with it, the business cost, war psychology and international socialism, pacifists, two kinds of war, the uninteresting war, a news story from Europe.

The control of hunger in health and disease. By ANTON JULIUS CARLSON. Chicago, University of Chicago Press (c. 1916). 319 p.

Carlson summarizes in this volume the work on the stomach carried out at the Hull Physiological Laboratory in Chicago during the past four years, with special reference to hunger and appetite. He has tried to present his digest in the light of the entire biological and clinical literature on the subject, hoping that it may encourage more intensive work on hunger and appetite control, especially in the field of clinical mechanism. The seventeen chapters discussed here, together with the reports of his extraordinary case constitute perhaps the most important contribution to the physiology of hunger and digestion since the ancient case of St. Martin whom it somewhat resembles.

The causation and treatment of psychopathic diseases. By BORIS SIDIS. Boston, Richard G. Badger, (c. 1916). 418 p.

In its make-up this is an exasperating book. The type is none too clear, nor the paper too good, the front edge is ragged and uncut, and in our attempts to cut it the paper tears.

Sidis is possessed with the idea that functional neuroses are not congenital but results of defective education in early child life, a view which is natural, if not necessary, for everyone engaged in therapy. It is the attitude also of hope that appeals to patients, parents and friends. We may well hope it is true. The author appears not to make any serious attempt to add substantially to his own theories or conclusions. He still believes in hypnoidization, and his chapters on psychopathic fears and the psychophysic substratum, the impulse of self-preservation, the law of reversion, embryonic personality, the sources of psychopathies:—these are all interesting.

Mental examination of two thousand delinquent boys and young men. By M. L. Beanblossom. Jeffersonville, Indiana Reformatory, 1916. 23 p.

The author concludes that imprisonment tends to accentuate abnormalities as well as mental eccentricities. There is a relation between the kind of crime and the type of intelligence. One's vocation or the absence of it is indicative of the type of intelligence. Barring the criminal by accident or mishap, we can say in general that all have the same sort of defects, although these are often so recondite that they are hard to get at.

A manual of nervous diseases. By Irving J. Spear. Philadelphia, W. B. Saunders Co., 1916. 660 p.

The large divisions of this work are as follows: Anatomy and Physiology of the Nervous System; Examination of the Patient; Diseases of the Peripheral Nerves; Diseases of the Muscular System; Diseases of the Spinal Cord; Diseases of the Brain; Diseases of the Brain and Spinal Cord; Diseases of the Nervous System without Pathologic Findings; Neurosis Characterized by Spasmodic Muscle Contractions; Diseases Due to Perversion of Secretion of the Ductless Glands; Diseases Due to Disturbances of the Vasomotor System; Trophoneuroses; Unclassified Disorders.

Mentally deficient children; their treatment and training. By G. E. Shuttleworth and W. A. Potts. 4th ed. Philadelphia, P. Blakiston's Son and Co., 1916. 284 p.

This is an amplified fourth edition of a work published in 1895 which is too well known for detailed review. It covers the history of the subject, treats especially of defective and epileptic children, methods of special instruction, physiological classification, the forms of mental deficiency, etiology, diagnosis, prognosis, psychopathies of puberty and adolescence, medical examination, treatment, education, industrial and moral training. The merit of the book is as a compend rather than as an original contribution.

A brief history of panics and their periodical occurrence in the United States. By Clement Juglar. Third edition, translated and edited with an introduction and brought down from 1889 to date by DeCourcy W. Thom. New York, G. P. Putnam's Sons, 1916. 189 p.

Panics continue to appear as usual but are less severe since 1890. They will never cease but must be abated slowly, as medicine abates disease. This history is entirely pragmatic, giving the bald facts about each panic and attempting very little in the way of generalization.

Problems of religion; an introductory survey. By DURANT DRAKE. Boston, Houghton Mifflin Co. (c. 1916). 425 p.

This book is divided into three parts, historical, going back to the Greeks, Buddhists, Jews, devoting a chapter to Jesus Christ, the founding of the Church, early Christianity, later Christianity and Mohammedanism; 2nd, psychological, treating the God of experience, sacrifice and sin, salvation, conversion and atonement, faith and prayer, religious love and peace, the essence of religion, and the Christian religion. The last part is philosophical and treats the theological method and the scientific spirit, the interpretation of the Bible, miracles, creation and design, interpretation of religious experience, pragmatic arguments, the counter-attack on science, problem of evil, immortality, and faith.

The relations of general intelligence to certain mental and physical traits. By CYRUS D. MEAD. Teachers College, Columbia University, Contributions to Education, No. 76. New York, 1916. 117 p.

Summing up this study of children's perception and memory, the author concludes that normal children are better at each age than defectives and girls better than boys in perception, although sexes differ less with the feeble-minded; that "schoolable" mentally defective children of sixteen or eighteen are not much better in these powers than normal children of eight. Defective children are at the very lower end of a larger distribution curve for children in general; and the best mental powers defectives are likely to bring to school are perception and memory.

How to learn easily; practical hints on economical study. By GEORGE VAN NESS DEARBORN. Boston, Little, Brown and Co., 1916. 227 p.

The chapters here are, Economy in Study; Observation and the Taking of Notes; Educative Imagination; Books and Their Educative Use; Is Your "Thinker" in Order? Examination-Preparedness.

The war and humanity; a further discussion of the ethics of the world war and the attitude and duty of the United States. By JAMES M. BECK. New York, G. P. Putnam's Sons, 1916. 322 p.

This is a work of seven chapters, as follows: The "Distress of Nations"; The Submarine Controversy; The Case of Edith Cavell; The Foreign Policy of President Washington; "Where There Is No Vision"; America and the Allies; The Vision of France.

The purpose of education. By ST. GEORGE LANE FOX PITT. Cambridge, University Press, 1916. 144 p.

Fox examines educational problems in the light of recent psychological research, printing a letter-preface from Émile Boutroux. The chief topics discussed are human personality, emotion and instinct, character versus reputation, incentives to effort, economics, specialization, multiplex environment, religions, ideals and the twice-born, the production of the ideal, and lessons of the war.

Ventilation in relation to mental work. By E. L. THORNDIKE, W. A. MCCALL and J. C. CHAPMAN. Teachers College, Columbia University, Contributions to Education, No. 78. New York, 1916. 83 p.

Measurements of some achievements in arithmetic. By CLIFFORD WOODY. Teachers College, Columbia University, Contributions to Education, No. 80. New York, 1916. 63 p.

Completion-test language scales. By MARION REX TRABUE. Teachers College, Columbia University, Contributions to Education, No. 77. New York, 1916. 118 p.

Adjustment of school organization to various population groups. By ROBERT ALEXANDER FYFE MCDONALD. Teachers College, Columbia University, Contributions to Education, No. 75. New York, 1916. 145 p.

Mortality statistics. 1914. Fifteenth annual report of the Department of Commerce, Bureau of the Census. Sam. L. Rogers, Director. Washington, Gov't Printing Office, 1916. 714 p.